

7.0 DEVELOPMENT OF LCA RESTORATION PLAN: RATIONAL FOR DEVELOPING THE LCA RESTORATION PLAN FROM THE ARRAY OF COASTWIDE FRAMEWORK PROJECT FEATURES (PHASE VI)

Upon the completion of Phase V efforts, with attention to the science and technology (S&T) uncertainties and model uncertainties, the PDT redirected the plan formulation effort towards definition of a plan that focused on critical restoration efforts in the near-term, the next 5 to 10 years. The PDT determined that a LCA Plan would best meet the overall study objectives through inclusion of several complementary plan components that differ in scale and time. These would include:

- Near-term, highly certain feature concepts for development and implementation;
- Identified, feature-related uncertainties and potential methods or features to resolve them; and
- Large-scale and long-range feature concepts to be more fully developed.

Having identified the most efficient, effective, and complete combinations, the features within the final array of coast wide frameworks were used as the starting point for the identification of alternative LCA Plans. These 79 restoration features that were combined into the coast wide frameworks of the final array primarily addressed areas of critical wetland loss, opportunities for the reestablishment of deltaic processes, and the protection and restoration of geomorphic features. The 79 features were the building blocks for alternative LCA Plans in Phase VI.

7.1 Description of the restoration features identified in the Final Array of Coast wide Frameworks

The PDT determined that the follow-on feasibility study process would analyze and optimize specific locations and dimensions for any restoration feature that would ultimately become a component of the LCA Plan that best met the objectives. Instead, general details about restoration features were included as part of this plan formulation process. For example, diversions were referred to as either small, medium, or large, where small equates to 1,000-5,000 cfs diversions, medium to 5,000-15,000 cfs diversions, and large to greater than 15,000 cfs diversions. More detailed cost information regarding the features is available at the District upon request. The features are shown on **figures MR-31 through MR-34** of the main report.

7.1.1 Subprovince 1 feature descriptions

Medium diversion at American/California Bays

This restoration feature provides for a medium non-structural, uncontrolled diversion from the Mississippi River at American/California Bays. The diversion feature would consist of an armored crevasse through the existing un-leveed riverbank into the fringe marsh and open water of the bay system. The objective of this feature is to increase sediment introduction into American/California Bays. The introduction of additional sediment would facilitate organic and mineral sediment deposition, improve biological productivity, and prevent further deterioration of the marshes.

Medium to large sediment diversion at American/California Bays

This restoration feature involves a large non-structural, uncontrolled sediment diversion from the Mississippi River with sediment enrichment at American/California Bays. The diversion feature would consist of an armored crevasse through the existing un-leveed riverbank into the fringe marsh and open water of the bay system. The objective of this feature is to maximize sediment inputs and spur large-scale land building in American/California Bays. This area was historically an outflow area of the Mississippi River, which received river discharges during flooding events. The creation and restoration of wetlands in American/California Bays would have the added benefit of stabilizing the Breton Sound marshes to the north by reducing marine influences from the Gulf of Mexico.

Rehabilitate Bayou Lamoque structure as a medium diversion

This feature provides for the refurbishment and operation of a pair of diversion structures, regulating the flow of Mississippi River water into Bayou Lamoque, a former tributary of the Mississippi River. The existing Bayou Lamoque diversion structures require mechanical rehabilitation and operational security modifications. The remote location of these structures and the frequent occurrence of vandalism have resulted in an inability to ensure consistent and reliable operation. The objective of this feature is to increase and maintain riverine inflows into Bayou Lamoque. The introduction of additional freshwater would facilitate organic and sediment deposition, improve biological productivity, and prevent further deterioration of the marshes. This feature is located in the vicinity of a historic crevasse.

Medium diversion at Bonnet Carre Spillway

This restoration feature would be located at the existing Bonnet Carre Spillway and involve a reevaluation of the existing authorized project. The spillway is currently operated to remove excess water from the Mississippi River during flooding events and pass the water through the Bonnet Carre Spillway into Lake Pontchartrain. The restoration feature consists of a medium diversion with east and west branches into the La Branche wetlands and Manchac land bridge - diverted through a modified segment of the existing flood control structure and redirected through the guide levees into adjacent wetlands. The objective of the project is to decrease salinities in Lake Pontchartrain and the surrounding marshes, especially the La Branche Wetlands, and to add nutrients and some sediment to these marshes and swamps. This feature is located in the vicinity of a historic crevasse.

Small diversion at Convent/Blind River

This restoration feature involves a small diversion from the Mississippi River into Blind River through a new control structure. The objective of this feature is to introduce sediments and nutrients into the southeast portion of Maurepas Swamp. This feature is intended to operate in conjunction with the Hope Canal diversion to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.

Medium diversion at Fort St. Philip

This restoration feature provides for a medium diversion from the Mississippi River into marshes northeast of Fort St. Philip, between the Mississippi River and Breton Sound. Objectives of this feature are to reduce wetland loss and facilitate riverine influences to these marshes. The diversion would facilitate organic deposition in and biological productivity of the marshes by increasing freshwater circulation and providing sediments and nutrients to the system.

Small diversion at Hope Canal (CWPPRA Maurepas diversion)

This restoration feature involves a small diversion from the Mississippi River through a new control structure at Hope Canal. The objective is to introduce sediments and nutrients into Maurepas Swamp south of Lake Maurepas. The introduction of additional freshwater via the diversion would facilitate organic deposition, improve biological productivity, and prevent further deterioration of the swamp. Work for this feature has been initiated in engineering and design and NEPA compliance under CWPPRA.

Medium diversion at White's Ditch

This restoration feature, located at White's Ditch, downstream of the Caernarvon diversion structure, provides for a medium diversion from the Mississippi River into the central River aux Chenes area using a controlled structure. The objective of the feature is to provide additional freshwater, nutrients, and fine sediments to the area between the Mississippi River and River aux Chenes ridges. This area is currently isolated from the beneficial effects of the Caernarvon freshwater diversion. The introduction of additional freshwater would facilitate organic sediment deposition, improve biological productivity, and prevent further deterioration of the marshes. This feature is located in the vicinity of a historic crevasse.

Sediment delivery via pipeline at American/California Bays

This restoration feature provides for sediment delivery via pipeline through programmatic sediment mining from the Mississippi River. The moderately deep (6 to 10 feet) open water in this bay system requires a large volume of sediment to create wetlands. The objective of this feature is to create wetlands in the American/California Bays.

Sediment delivery via pipeline at Central Wetlands

This restoration feature provides for placement of sediment mined from the Mississippi River into the Central Wetlands adjacent to the MRGO and Violet canal, via pipeline. The objective of this feature is to enhance and create wetlands by placing dredged sediments in the shallow (1 to 2 feet) open waters of the marshes. Placement of this dredged material would counteract marsh breakup by providing sediment and nutrients to renourish the area. This feature is located in the vicinity of a historic crevasse.

Sediment delivery via pipeline at Fort St. Philip

This feature provides for sediment delivery at Fort St. Philip via programmatic sediment mining from the Mississippi River. The objective of the feature is to create and/or restore marsh habitat by depositing sediment in appropriate moderately shallow (3 to 5 feet) open water areas in the vicinity of Fort St. Philip. Enhancement of these marshes would facilitate biological productivity of the marshes and reduce wetland loss.

Sediment delivery via pipeline at Golden Triangle

This restoration feature provides for sediment delivery via sediment mined from the Mississippi River and placed in the area formed by the confluence of the MRGO, GIWW, and Lake Borgne. The objective of the feature is to create and/or restore marsh habitat by depositing sediment in appropriate shallow (1 to 2 feet) open water in the area adjacent to these three water bodies. Enhancement of these marshes would facilitate biological productivity of the marshes and reduce wetland loss.

Sediment delivery via pipeline at La Branche Wetlands

The proposed restoration feature includes the dedicated dredging of sediment from the Mississippi River, which would be delivered via pipeline to shallow (1 to 2 feet) open waters within the La Branche Wetlands in the southwest corner of Lake Pontchartrain. The creation and restoration of these marshes would facilitate improved biological productivity and reduce wetland loss. This feature is located in the vicinity of a historic crevasse.

Sediment delivery via pipeline at Quarantine Bay

This restoration feature provides for sediment delivery to Quarantine Bay via programmatic sediment mining from the Mississippi River. The objective of the feature would be to create wetland habitat through the placement of dredge sediments in the moderately shallow (3 to 5 feet) open waters of Quarantine Bay.

Opportunistic use of Bonnet Carre Spillway (CWPPRA project)

This restoration feature involves freshwater introductions from the Mississippi River via the opportunistic use of the existing flood control structure at the Bonnet Carre Spillway. The spillway is currently operated to remove excess water from the Mississippi River during flooding events and pass the water through the Bonnet Carre Spillway into Lake Pontchartrain. This feature would allow for freshwater introductions to be delivered to Lake Pontchartrain and the adjacent La Branche wetlands during times of high river water levels. Thus, the river introductions would help reduce salinities in the southwest corner of Lake Pontchartrain and nourish the intermediate and brackish marshes in La Branche with sediment and nutrients. This feature is located in the vicinity of a historic crevasse.

Increase Amite River Diversion Canal influence by gapping banks

This restoration feature involves the construction of gaps in the existing dredged material banks of the Amite River Diversion Canal. The objective of this feature is to allow floodwaters to introduce additional nutrients and sediment into western Maurepas Swamp. The exchange of flow would occur during flood events on the river and from the runoff of localized rainfall

events. This feature would provide nutrients and sediment to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.

Marsh nourishment on New Orleans East land bridge

This restoration feature involves wetland creation through the dedicated dredging of sediments from lake bottom sources. The objective of this feature is to create wetlands by placing dredged sediments in the shallow open waters within the land bridge separating Lakes Pontchartrain and Borgne. This area has experienced wetland deterioration and loss due to erosion from wave energies in Lake Borgne. Reinforcing the land bridge between the two lakes would help maintain the salinity gradients in Lake Pontchartrain and ensure the long-term sustainability of the wetland ecosystems in the area.

Mississippi River Delta Management Study

This restoration concept requires detailed investigations to address the maximization of river resources, such as excess freshwater and sediments, for wetland restoration. The objective of this concept is to greatly increase the deposition of Mississippi River sediments on the shallow continental shelf, while ensuring navigation interests. Sediment, nutrients, and freshwater would be re-directed to restore the quality and sustainability of the Mississippi River Deltaic Plain, its coastal wetland complex, and the Gulf of Mexico. The study would investigate potential modifications to existing navigation channel alignments and maintenance procedures and requirements.

Mississippi River Gulf Outlet (MRGO) environmental restoration features

This restoration opportunity involves the implementation of the environmental restoration features under consideration by the MRGO Environmental Restoration Study. In response to public concerns, adverse environmental effects, and national economic development considerations, an ongoing study is re-evaluating the viability of operation and maintenance of this authorized navigation channel. Since the construction of the MRGO, saltwater intrusion and boat wake erosion have degraded large expanses of freshwater marshes and accelerated habitat switching from freshwater marshes to brackish and intermediate marshes in the Biloxi marshes, the Central Wetlands, and the Golden Triangle wetlands. This environmental restoration study would evaluate the stabilization of the MRGO banks and various environmental restoration projects, including evaluation of freshwater reintroductions into the Central Wetlands and possible channel depth modification. Implementation of this feature would result in hydrologic restoration.

Modification of Caernarvon diversion

The Caernarvon diversion structure, constructed on the Mississippi River in 1992 near the Breton Sound marshes, has a maximum operating capacity of 8,000 cfs. The structure has been operated as a salinity management feature, with freshwater introductions ranging between 1,000 cfs to 6,000 cfs, but in general averaging something less than half of the structure's capacity. The primary purpose of the existing Caernarvon project has been to maintain salinity gradients in the central portion of Breton Sound. This operation, in effect, partially restored the historic functions of marsh nourishment (e.g., freshwater inflow, providing nutrients and sediment to the marsh, and countering the effects of subsidence). The proposed restoration feature would seek an authorization change of the Caernarvon project purpose to include wetland

creation and restoration, thereby altering the project's operational plan. This would allow an increase in the freshwater introduction rate, perhaps 5,000 cfs on average, to accommodate the wetland building function of the system. The introduction of additional freshwater would facilitate organic and sediment deposition, improve biological productivity, and prevent further deterioration of the marshes. This feature is located in the vicinity of a historic crevasse.

Rehabilitate Violet Siphon for enhanced influence to Central Wetlands

This restoration feature involves the rehabilitation of the existing Violet Siphon water control structure, which is located between the Mississippi River and the MRGO, in the Central Wetlands. The objectives of this feature are to improve the operation of the Violet Siphon and enhance freshwater flows into the Central Wetlands. This action would increase freshwater in the wetlands and nourish the remaining swamp and intermediate marshes. The success of this feature would be enhanced with the freshwater introductions via the IHNC lock feature. This feature is located in the vicinity of a historic crevasse.

Post authorization change for the diversion of water through Inner Harbor Navigation Canal for enhanced influence into Central Wetlands

This restoration feature calls for a post-authorization modification of the IHNC lock. Modifications would incorporate culverts and controls to divert freshwater from the Mississippi River through the IHNC to the Central Wetlands. The objectives of this feature are to introduce freshwater and nutrients into the intermediate and brackish marshes of the Central Wetlands, boost plant productivity, and reduce elevated salinities. This restoration feature could also enhance the effect of the Violet Siphon structure rehabilitation restoration feature.

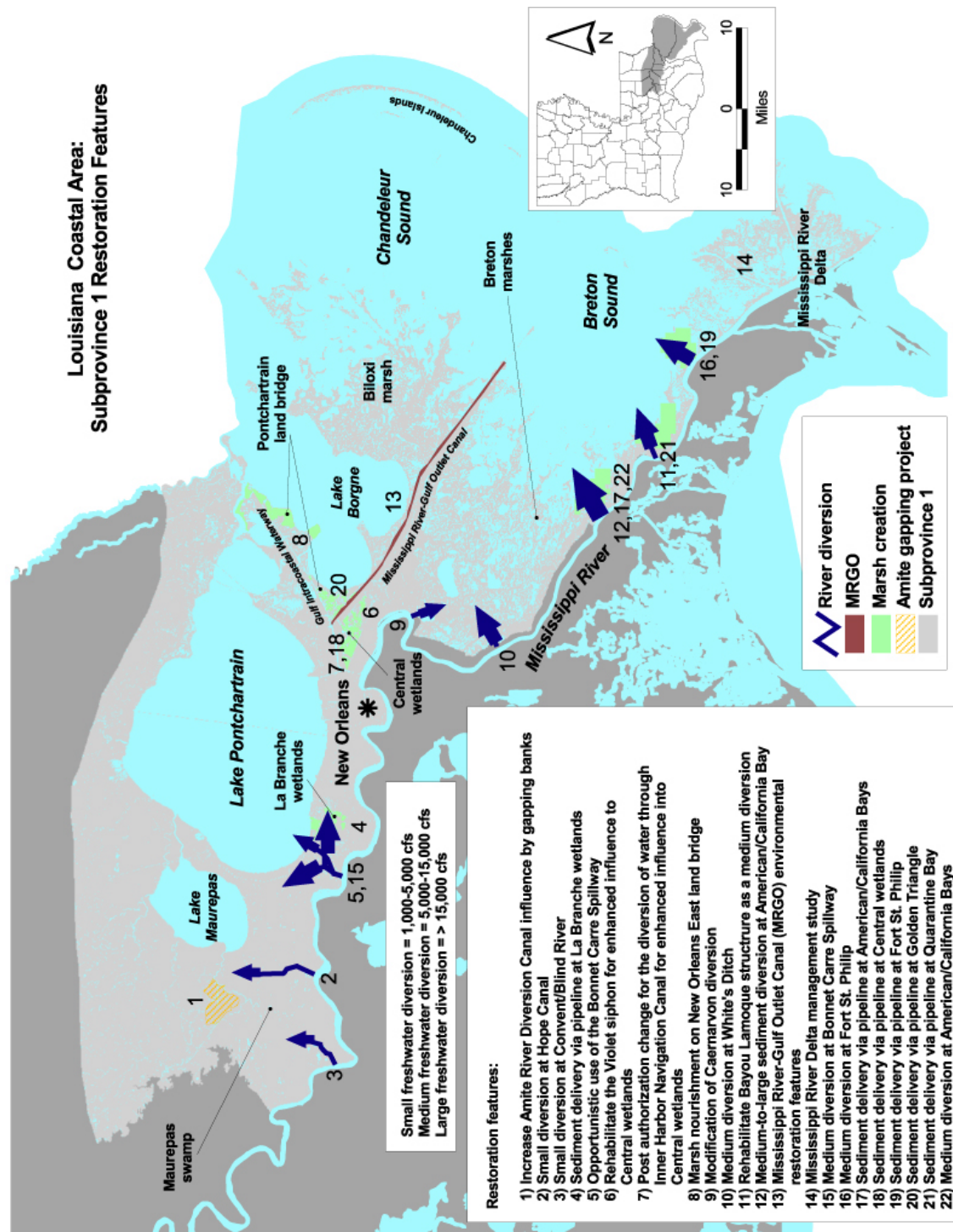


Figure E-46. Subprovince 1 Restoration Features Identified in the Final Array of Coast Wide Frameworks.

7.1.2 Subprovince 2 Feature Descriptions

Large diversion at Boothville with sediment enrichment

This restoration feature provides for a large nonstructural, uncontrolled sediment diversion from the Mississippi River near Boothville into the Yellow Cotton/Hospital Bays area. The objective of this feature is to create wetlands by diverting sediments in the moderately deep (6 to 10 feet) open waters of Yellow Cotton / Hospital Bays. The freshwater and nutrients would also increase vegetative stability in the fringing marshes and along the Bayou Grand Liard ridge. Ultimately, sediments would reach and supplement the barrier shoreline between Red Pass and the Empire to the gulf waterway. Sediment enrichment assumes use of 20-inch dredge at capacity for three months yielding 1,468,000 yd³ each year. The diversion would maximize sediment and nutrient inputs and spur large-scale land building in the extreme southeastern portion of Barataria Bay.

Small diversion at Donaldsonville

This restoration feature involves a small diversion from the Mississippi River through a new control structure at Donaldsonville. The objective is to introduce freshwater, sediments, and nutrients into upper Bayou Verret, which is located to the northwest of Lac Des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in the area is classified as wetland forest, consisting primarily of bottomland hardwood forests. This feature is intended to operate in conjunction with three other small diversions in the area.

Small diversion at Edgard

This restoration feature involves a small diversion from the Mississippi River through a new control structure at Edgard. The objective is to introduce freshwater, sediments, and nutrients into Bayou Fortier, which is located to the northeast of Lac Des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in the area is classified as wetland forest, consisting primarily of bottomland hardwood forest. This feature is intended to operate in conjunction with three other small diversions in the area.

Medium diversion at Edgard with sediment enrichment

This restoration feature involves a medium diversion from the Mississippi River through a new control structure at Edgard. The objective is to introduce freshwater, sediments, and nutrients into Bayou Fortier, which is located to the northeast of Lac Des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in the area is classified as wetland forest, consisting primarily of bottomland hardwood forest. Sediment enrichment would involve use of 12-inch dredge for three months. Discharge of effluent upstream of the diversion intake would allow the capture of silts and very fine sands only.

Medium diversion at Fort Jackson - Alternative to Boothville diversion

This restoration feature provides for a medium non-structural, uncontrolled sediment diversion from the Mississippi River near Fort Jackson into the Yellow Cotton/Hospital Bays area. The objective of this feature is to create wetlands by diverting sediments in the moderately deep (6 to 10 feet) open waters of Yellow Cotton/Hospital Bays. The associated freshwater and nutrients would also increase vegetative stability in the fringing marshes and along the Bayou Grand Liard ridge. The diversion would maximize sediment and nutrient inputs and spur land building in the extreme southeastern portion of Barataria Bay.

Large diversion at Fort Jackson with sediment enrichment - Alternative to Boothville diversion

This restoration feature provides for a large (50,000 to 100,000 cfs) non-structural, uncontrolled sediment diversion from the Mississippi River near Fort Jackson into the Yellow Cotton/Hospital Bays area. The objective of this feature is to create wetlands by diverting sediments in the moderately deep (6 to 10 feet) open waters of Yellow Cotton / Hospital Bays. The associated freshwater and nutrients would also increase vegetative stability in the fringing marshes and along the Bayou Grand Liard ridge. Sediment enrichment assumes use of 20-inch dredge at capacity for three months yielding 1,468,000 yd³ each year. Ultimately, sediments would reach and supplement the barrier shoreline between Red Pass and the Empire to the gulf waterway. The diversion would maximize sediment and nutrient inputs and spur large-scale land building in the extreme southeastern portion of Barataria Bay.

Small diversion at Lac des Allemands

This restoration feature involves a small diversion from the Mississippi River through a new control structure at Lac Des Allemands. The objective is to introduce freshwater, sediments, and nutrients into Bayou Becnel, which is located to the north of Lac Des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in Bayou Becnel and surrounding Lac Des Allemands area is classified as wetland forest, consisting primarily of bottomland hardwood forest. This feature is intended to operate in conjunction with three other small diversions in the area.

Medium diversion at Lac des Allemands with sediment enrichment

This restoration feature involves a medium diversion from the Mississippi River through a new control structure at Lac Des Allemands. The objective is to introduce freshwater, sediments, and nutrients into Bayou Becnel, which is located to the north of Lac Des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in Bayou Becnel and surrounding Lac Des Allemands area is classified as wetland forest, consisting primarily of bottomland hardwood forest. Sediment enrichment would involve use of 12-inch dredge for three months. Discharge of effluent upstream of the diversion intake would allow the capture of silts and very fine sands only. This feature is intended to operate in conjunction with three small diversions in the area.

Medium diversion with dedicated dredging at Myrtle Grove

This restoration feature involves a medium diversion of the Mississippi River near Myrtle Grove through a new control structure. The diversion would provide additional sediment and nutrients to nourish highly degraded existing fresh to brackish wetlands in shallow open water areas. This reintroduction would ensure the long-term sustainability of these marshes by increasing plant productivity, thereby preventing future loss. The introduction of sediment to this area would also promote the infilling of shallow open water areas both through deposition and marsh expansion. Dedicated dredging of sediment mined from the Mississippi River would complement this feature. This feature is located in the vicinity of a historic crevasse. Work has been initiated on engineering and design and NEPA compliance under CWPPRA.

Large diversion at Myrtle Grove with sediment enrichment

This restoration feature involves a large sediment diversion from the Mississippi River near Myrtle Grove through a new control structure. The diversion would provide additional sediment and nutrients to nourish highly degraded existing fresh to brackish wetlands in shallow open water areas throughout the central Barataria basin. This reintroduction would allow the creation of new wetland in expansive open water and bay areas and ensure the long-term sustainability of currently degraded marshes by increasing plant productivity, thereby preventing future loss. The additional introduction of sediment by enrichment assumes use of 30-inch dredge at capacity for three months yielding 6,293,000 yd³ each year. This feature is located in the vicinity of a historic crevasse.

Small diversion at Pikes Peak

This restoration feature involves a small diversion from the Mississippi River through a new control structure at Pikes Peak. The objective is to introduce freshwater, sediments and nutrients into Bayou Chevreuil, which is located to the north of Lac Des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in the area is classified as wetland forest, consisting primarily of bottomland hardwood wetlands. This feature is intended to operate in conjunction with three other small diversions in the area.

Barataria Basin barrier shoreline restoration

This restoration feature involves mining of offshore sediment sources to reestablish sustainable barrier islands. The feature is based on designs developed in the LCA Barataria Barrier Island Restoration study and assumes a 3,000-foot wide island footprint. The critical areas include the Caminada-Moreau Headland (an area between Belle Pass and Caminada Pass) and Shell Island (a barrier island in the Plaquemines barrier island system). These barrier shoreline segments are critical components of the Barataria shoreline. The Shell Island segment has been nearly lost and failure to take restorative action could result in the loss of any future options for restoration. This would result in permanent modification of the tidal hydrology of the Barataria Basin. The Caminada-Moreau Headland protects the highest concentration of near-gulf oil and gas infrastructure in the coastal zone. This reach of the Barataria shoreline also supports the only land-based access to the barrier shoreline in the Deltaic Plain.

Implement the LCA Barataria Basin Wetland Creation and Restoration Study

This feature involves implementation of components of the LCA Barataria Basin Wetland Creation and Restoration Study. The wetlands in the lower Barataria Basin have experienced wetland deterioration due to subsidence, a lack of circulation, saltwater intrusion, and a paucity of sediment and nutrients. Sediment dredged from offshore borrow sites would be placed at specific sites near Bayou Lafourche in the Caminada Headland to create and restore marsh and ridge habitat in the area.

Modification of Davis Pond diversion for increased sediment input

The Davis Pond diversion structure, constructed in 2002 in upper Barataria Basin, has a maximum operating capacity of 10,600 cfs. The structure has been operated as a salinity management feature, with freshwater introductions from the Mississippi River ranging from 1,000 cfs up to 5,000 cfs averaging, to this point in time, considerably less than half of the structure's capacity. The primary purpose of the existing Davis Pond project has been to

maintain salinity gradients in the central portion of Barataria Basin. This operation, in effect, partially restored the historic functions of marsh nourishment (e.g., freshwater inflow, providing nutrients and sediment to the marsh, and countering the effects of subsidence). This restoration feature would seek an authorization change of the Davis Pond project purpose to include wetland creation and restoration, thereby altering the project's operational plan. This would allow an increase in the freshwater introduction rate, perhaps 5,000 cfs on average, to accommodate the wetland building function of the system. The introduction of additional freshwater would facilitate organic and sediment deposition, improve biological productivity, and prevent further deterioration of the marshes. This feature is located in the vicinity of a historic crevasse.

Sediment delivery via pipeline at Bastian Bay/Buras

This restoration feature provides for sediment delivery via pipeline through programmatic sediment mining from the Mississippi River. The moderately deep (6 to 10 feet) open water in this bay system requires a large volume of sediment to create wetlands. The objective of this feature is to create wetlands in the highly degraded Bastian Bay and Buras area.

Sediment delivery via pipeline at Empire

This restoration feature provides for sediment delivery via pipeline through programmatic sediment mining from the Mississippi River. The moderately deep (6 to 10 feet) open water in Bay Adams and Barataria Bay requires a large volume of sediment to create wetlands. The objective of this feature is to create wetlands in the highly degraded areas south and west of Empire.

Sediment delivery via pipeline at Main Pass (Head of Passes)

This feature provides for sediment delivery via programmatic sediment mining from the Mississippi River utilizing a sediment trap above the Head of Passes. The estimated annual yield of dredge material from the sediment trap is 9 million cubic yards. The objective of this feature is to create wetlands in the degraded areas in the east and west portions of the Mississippi River Delta south of Venice.

Third Delta (Subprovinces 2 & 3)

This feature provides for a large diversion from the Mississippi River through a new control structure in the vicinity of Donaldsonville. This feature provides for an approximately 240,000 cfs diversion at maximum river stage. Flows would be diverted into a newly constructed conveyance channel (parallel to Bayou Lafourche) extending approximately 55 miles from the initial point of diversion to the eventual point of discharge. Diverted flow would be divided equally at a point north of the GIWW to enable the creation of a deltaic wetlands complex in each of the Barataria and Terrebonne Basins. A possible alternative configuration would involve a 120,000 cfs diversion at maximum river stage into the Barataria Basin only. Enrichment of this diversion would also be considered and assumes use of 30-inch dredge at capacity for three months yielding 6,293,000 yd³ each year. The study requires significant investigations of flood control, drainage, and navigation impacts in addition to environmental and design efforts.

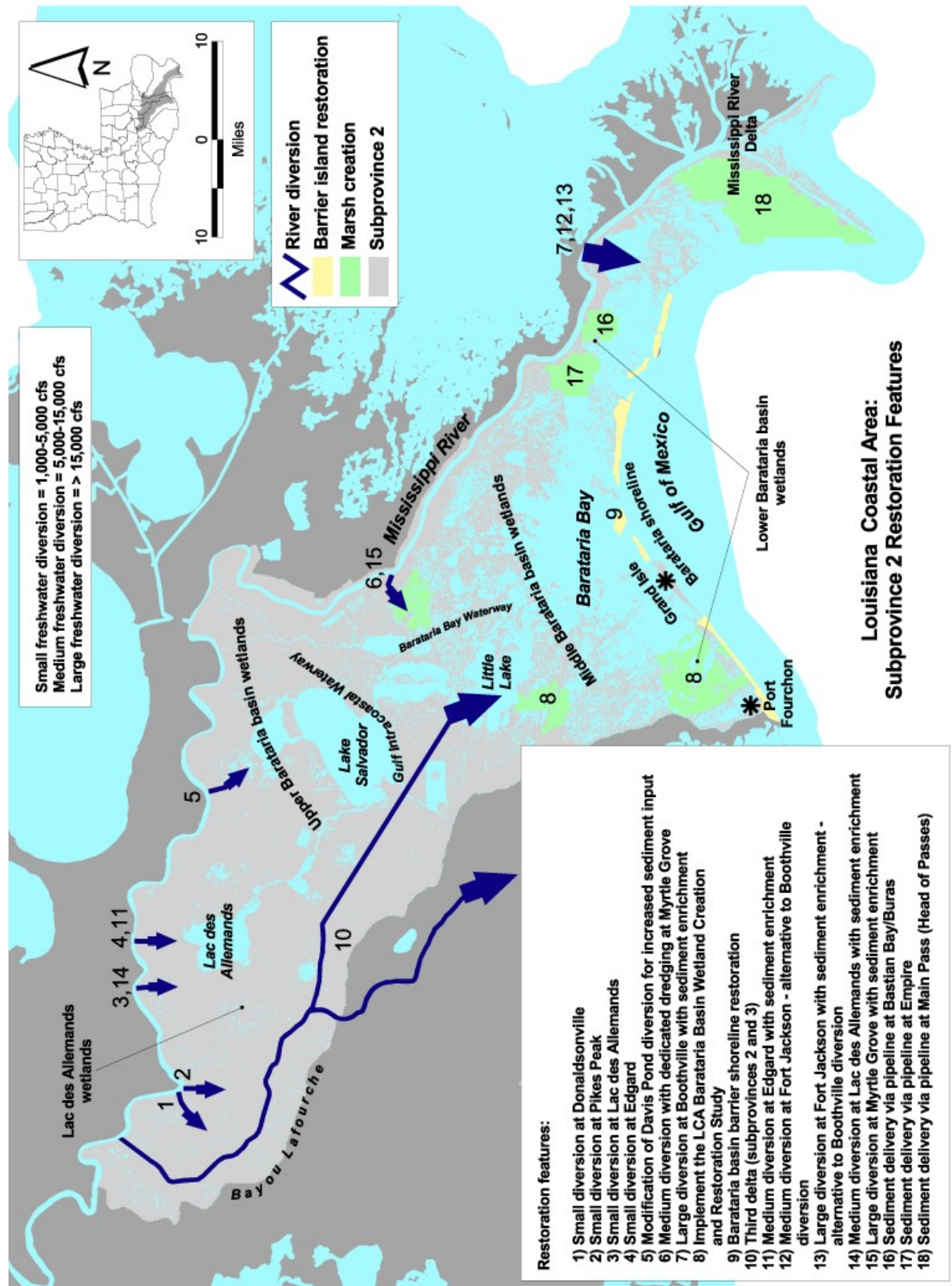


Figure E-47. Subprovince 2 Restoration Features Identified in the Final Array of Coast Wide Frameworks.

7.1.3 Subprovince 3 feature descriptions

Backfill pipeline canals

This restoration feature provides for the backfilling of pipeline canals south of Catfish Lake. The Twin Pipeline canals in this area are crossed by numerous oilfield canals, which have greatly altering natural water circulation patterns. The 63,300 feet of pipeline canals would be filled at strategic locations to restore primary water circulation through Grand Bayou Blue. The retention time of Atchafalaya and Bayou Lafourche (pumped) flows would be increased to benefit affected wetlands.

Small Bayou Lafourche reintroduction

This restoration feature would reintroduce flow from the Mississippi River into Bayou Lafourche. The piped flow would be continuous and would freshen and reduce loss rates for the wetlands between Bayous Lafourche and Terrebonne, south of the GIWW.

Convey Atchafalaya River water to Terrebonne marshes via a small diversion in the Avoca Island levee, repairing eroding banks of the GIWW, and enlarging constrictions in the GIWW below Gibson and in Houma, and Grand Bayou conveyance channel construction/enlargement.

This restoration feature would enhance existing Atchafalaya River influence to central (Lake Boudreaux) and eastern (Grand Bayou) Terrebonne marshes via the GIWW by introducing flow into the Grand Bayou basin by enlarging the connecting channel (Bayou L'Eau Bleu) to capture as much of the surplus flow (max. 2000 to 4000 cfs) that would otherwise leave the Terrebonne Basin. Several alternatives would be evaluated through hydrologic models; however in all cases, gated control structures would be installed to restrict channel cross-section to prevent increased saltwater intrusion during the late summer and fall when riverine influence is typically low. Some alternatives may include auxiliary freshwater distribution structures. This feature also includes repairing banks along the GIWW and enlarging constrictions in the GIWW.

Freshwater introduction south of Lake De Cade

This restoration feature is intended to enhance Atchafalaya flows to Terrebonne wetlands between Lake De Cade, Bayou du Large, and Lake Mechant by constructing three small conveyance channels along the south shore of Lake De Cade to the Small Bayou La Pointe area. Channel flows would be controlled by structures that could be actively operated. Lowering salinities and increasing nutrient inputs would reduce intermediate marsh losses.

Freshwater introduction via Blue Hammock Bayou

This restoration feature would increase flow from the Atchafalaya River to the southwest Terrebonne wetlands by increasing the cross-section of Blue Hammock Bayou. This would increase the distribution of Atchafalaya flows from Four League Bay to the Lake Mechant wetlands. Grand Pass and Buckskin Bayou, outlets of Lake Mechant, would be reduced in cross section to increase the retention and benefits of Atchafalaya nutrients, sediment, and freshwater in these estuarine wetlands. Additional marsh would also be created with dredged material.

Increase sediment transport down Wax Lake Outlet

This restoration feature would increase sediment transport down Wax Lake Outlet by extending the outlet northward through Cypress Island to connect to the Atchafalaya Main Channel. Currently, the Wax Lake Outlet flows passes over the relatively shallow Six Mile Lake

before entering the outlet. This restoration feature would connect the deep outlet directly to the deep Atchafalaya Main Channel thereby increasing bed load sediments transported to the Wax Lake Outlet Delta.

Maintain land bridge between Caillou Lake and Gulf of Mexico

This restoration feature would maintain the land bridge between the gulf and Caillou Lake by placing shore protection in Grand Bayou du Large to minimize saltwater intrusion. This feature would involve rock armoring or marsh creation to plug/fill broken marsh areas on the west bank of lower Grand Bayou du Large, to prevent a new channel from breaching the bayou bank and allowing a new connection with Caillou Lake. Some gulf shore armoring would be needed to protect these features from erosion on the gulf shoreline. Gulf shoreline armoring might be required where shoreline retreat and loss of shoreline oyster reefs has allowed increased water exchange between the gulf and the interior water bodies (between Bay Junop and Caillou Lake). Some newly opened channels would be closed to restore historic cross-sections of exchange points. By reducing marine influences in these interior areas, this feature would allow increased freshwater influence from Four League Bay to benefit area marshes.

Maintain land bridge between Bayous du Large and Grand Caillou

This restoration feature provides for construction of a land bridge between Bayous du Large and Grand Caillou south of Falgout Canal and northeast of Caillou Lake. A grid of numerous trenasses, a small human-made channel for navigation, has artificially increased the hydrologic connection between interior marshes with Caillou Lake and adjoining water bodies. This problem would be addressed by depositing hydraulically dredged material to close the trenasses and areas of broken marsh to create a continuous berm of “high marsh” in the area. This berm would separate the higher, healthy brackish/saline marshes bordering the northeast end of Caillou Lake from the deteriorating inland intermediate/brackish marshes. It would also allow the freshwater flowing down the HNC and Bayou Grand Caillou to have a greater influence on interior marshes through existing water exchange points along Bayou Grand Caillou, north of the proposed land bridge.

Maintain northern shore of East Cote Blanche Bay at Point Marone

This restoration feature would protect the north shore of East Cote Blanche Bay from Point Marone to Jackson Bayou. Bay shoreline would be stabilized to protect the interior wetland water circulation patterns in the Cote Blanche Wetlands CWPPRA project. The feature was designed to increase the retention time of the Atchafalaya flows moving from the GIWW to East Cote Blanche Bay.

Maintain Timbalier land bridge

This restoration feature provides for maintaining the Timbalier land bridge in the upper salt marsh zone. A grid of numerous trenasses has artificially increased the hydrologic connection between interior marshes with Caillou Lake and adjoining water bodies. This problem would be addressed by depositing hydraulically dredged material to close the trenasses and areas of broken marsh to create a continuous berm of “high marsh” extending from Bayou Terrebonne to Bayou Lafourche. This berm would allow the freshwater flowing down from the GIWW through Grand Bayou to have a greater influence on interior marshes through existing water exchange points along Grand Bayou north of the proposed land bridge.

Multi-purpose operation of Houma Navigation Canal (HNC) Lock

The restoration feature involves the multi-purpose operation of the proposed HNC Lock, located at the southern end of the HNC. The Morganza to the Gulf Hurricane Protection Study includes construction of the lock, but does not include the multi-purpose operation of the lock. The objective of this feature is to make more efficient use of Atchafalaya River waters and sediment flow, as well as maintain salinity regimes favorable for area wetlands. The proposed structure would be operated to restrict saltwater intrusion and distribute freshwater and sediments during times of high Atchafalaya River flow. The current project is designed to limit saltwater intrusion, but with a minor modification would provide additional benefits to the wetlands by increasing retention time of Atchafalaya River water in the Terrebonne Basin wetlands. An increased retention time would provide additional sediment and nutrients to nourish the wetlands and would benefit the forested wetlands, and fresh, intermediate, and brackish marshes adjacent to the lock and canal; the Lake Boudreaux wetlands to the north; the Lake Mechant wetlands to the west; and the Grand Bayou wetlands to the east.

Optimize flows and Atchafalaya River influence in Penchant Basin

This restoration feature involves the implementation of the Penchant Basin Plan. This would increase the efficiency of Bayou Penchant to convey flows from the area wetlands as Atchafalaya River stages fall after spring floods, and reduce excessive water levels in the upper Penchant Subbasin. Increased outlet capacities would utilize flow, increasing circulation and retention in tidal wetlands below the large fresh floating marsh zone.

Rebuild Historic Reefs - rebuild historic barrier between Point Au Fer and Eugene Island and construct segmented reef/breakwater/jetty along the historic Point Au Fer Barrier Reef from Eugene Island extending towards Marsh Island to the west

This restoration feature would enhance Atchafalaya Delta growth and Atchafalaya River influence in Atchafalaya Bay, Point Au Fer Island, and Four League Bay by rebuilding the historic barrier between Point Au Fer and Eugene Island. This barrier would separate these areas from the gulf following the historic Point Au Fer reef alignment. The barrier could be a reef, a barrier island, an intertidal spit, or a segmented breakwater. The barrier would increase delta development by reducing the erosive wave effects. Atchafalaya River freshwater influence would be increased in the interior areas of the Atchafalaya Basin. Constructing a segmented reef/breakwater/jetty along the historic Point Au Fer barrier reef from Eugene Island extending towards Marsh Island to the west would produce similar beneficial effects in the western portion of Atchafalaya Bay. The barrier would join the Bayou Sale natural levee feature.

Acadiana Bay estuarine restoration

This restoration feature provides for rebuilding historic Point Chevreuil Reef toward Marsh Island, and rehabilitating the Bayou Sale natural levee between Point Chevreuil and the gulf. The natural levee would be rebuilt in the form of a shallow sub-aqueous platform, small islands, and/or reefs. The historic shell reefs were removed by shell dredging. This feature was designed to help restore historic hydrologic conditions in the Teche/Vermilion Basin.

Rehabilitate northern shorelines of Terrebonne/Timbalier Bays

This feature provides for the rehabilitation of the northern shorelines of Terrebonne/Timbalier Bays with a segmented breakwater from the Seabreeze area to the Little Lake area. This feature would rebuild and maintain the historic shoreline integrity around Terrebonne and Timbalier Bays by constructing segmented barriers along the west side of Terrebonne Bay, across the historic shoreline alignment along the northern sides of both bays, and along the eastern side of Timbalier Bay.

Relocate the Atchafalaya Navigation Channel

This restoration feature consists of relocating the Atchafalaya Navigation Channel. The navigation channel route through the delta has been identified as the greatest impediment to the delta's growth. By rerouting the channel between the delta lobes, and by using a passive hydraulic structure at the point of departure in the Lower Atchafalaya River, river sediment would be used more efficiently in the growing delta.

Terrebonne Basin barrier shoreline restoration

This restoration feature provides for the restoration of the Timbalier and Isles Dernieres barrier island chains. This would simulate historical conditions by reducing the current number of breaches, enlarging (width and dune crest) of the Isles Dernieres (East Island, Trinity Island, and Whiskey Island) and East Timbalier Island.

Stabilize banks of Southwest Pass

This restoration feature would maintain the integrity of Southwest Pass of the Atchafalaya River by protecting its bay and gulf shorelines. This feature would involve the construction of a dike and armoring of the banks of the pass to maintain the existing pass dimensions.

Gulf shoreline stabilization at Point Au Fer Island

This feature provides for stabilizing of the gulf shoreline of Point Au Fer Island. The purpose is to prevent direct connections from forming between the gulf and interior water bodies as the barrier island is eroded. In addition to gulf shoreline protection, this feature would prevent the fresher bay side water circulation patterns from being influenced directly by the gulf, thus protecting the estuarine habitat, which has higher quality wetland habitats, from conversion to marine habitat.

Alternative operational schemes of Old River Control Structure (ORCS)

This feature would evaluate alternative ORCS operational schemes with a goal of increasing the sediment load transported by the Atchafalaya River for the purpose of benefiting coastal wetlands. Detailed studies of this feature would determine: impacts (beneficial and adverse) to the interior of the Atchafalaya Basin; the degree to which flow and sediment redistributions would be required; and the increased costs of maintaining the flood control, navigation, and environmental features along the Lower Mississippi, Red, and Atchafalaya Rivers.

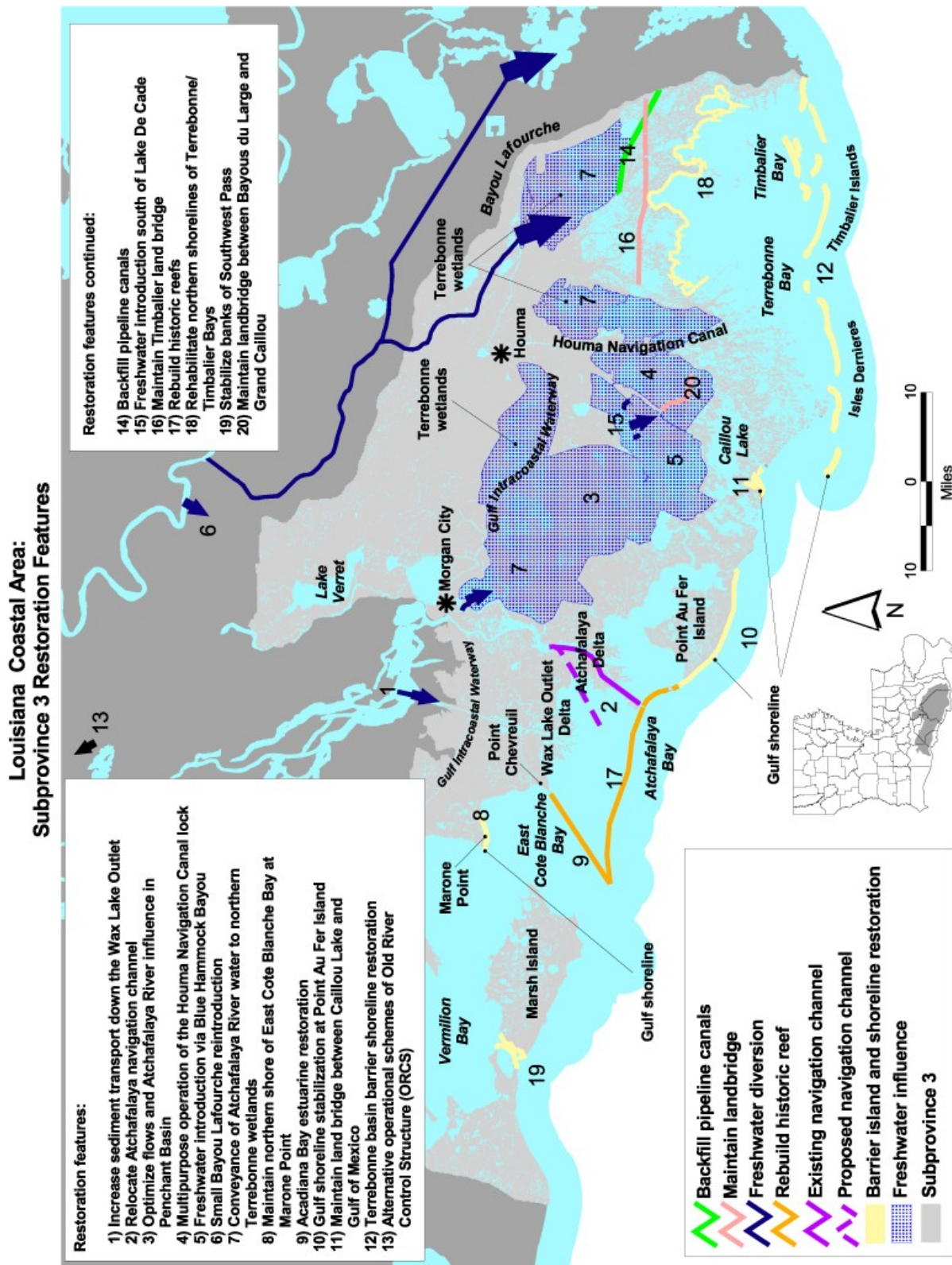


Figure E-48. Subprovince 3 Restoration Features Identified in the Final Array of Coast Wide Frameworks.

7.1.4 Subprovince 4 feature descriptions

Black Bayou bypass culverts

This restoration feature involves the replacement of the Calcasieu Lock in the GIWW west of the Hwy 384 Bridge and uses the old lock for freshwater introduction to the upper Calcasieu estuary from the Mermentau Basin. This feature also incorporates freshwater introduction via the Black Bayou Culverts feature at the intersection of Black Bayou and Hwy 384.

Calcasieu Ship Channel Beneficial Use

This feature capitalizes on the existing navigation maintenance activity by expanding beneficial use of dredged material from the Calcasieu Ship Channel. It accomplishes this by extending the application of material dredged from the channel for routine maintenance beyond the normal standard. Average annual maintenance dredging volume is approximately 4,000,000 cubic yards. The expanded use of this material would result in wetland creation over 50 years of application.

Chenier Plain freshwater management and allocation reassessment

This restoration opportunity requires detailed investigations involving water allocation needs and trade-off analysis in the eastern Chenier Plain, including the Teche/Vermilion Basin, to provide for wetland restoration and support continued agriculture and navigation in the region. A series of navigation and salinity control structures are currently authorized and operated in the eastern portion of the Chenier Plain. These structures maintain a freshwater source for agricultural applications and prevention of salinity intrusion in the area. Tidal stages have predominantly exceeded stages within the managed area creating a ponding issue for the fresh and intermediate marshes in the area. In addition, the natural ridges that define this area continue to be impacted by erosion, further threatening the ability for continued management and sustainability of the interior marshes. The study would address water management and allocation issues including salinity control, drainage, and fisheries accessibility.

Dedicated dredging for marsh restoration

This restoration feature would apply dredged material from offshore sources beneficially to restore subsided wetlands on Sabine National Wildlife Refuge (NWR) and adjacent properties. Locations for marsh restoration would be north and northwest of Browns Lake on Sabine NWR. Average open water depth is 1.5 to 2 feet deep.

East Sabine Lake hydrologic restoration

This restoration feature involves restoration of East Sabine Lake between Sabine Lake and Sabine NWR Pool 3. This feature would include salinity control structures at Willow Bayou, Three Bayou, Greens Bayou, and Right Prong of Black Bayou. Sediment terracing would also be used in shallow open water areas along with shoreline protection along Sabine Lake and some smaller structures.

Freshwater introduction at Highway 82

This restoration feature provides for drainage of “excess” freshwater from the Mermentau Basin Lakes Subbasin across Hwy 82 to the Chenier Subbasin at the Highway 82 area between Rollover Bayou and Superior Canal to the eastern portion of Rockefeller Refuge. This

introduction would involve the replacement or modification of culverts under Hwy 82. The objective of this feature is to relieve elevated stages in the northern area and provide freshwater input to the brackish and intermediate marshes to the south. This feature is intended to work in concert with four other restoration feature located along the Hwy 82 alignment.

Freshwater introduction at Little Pecan Bayou

This restoration feature provides for drainage of “excess” freshwater from the Mermentau Basin Lake Subbasin across Hwy 82 to the Chenier Subbasin west of Rockefeller Refuge at the Thibodeaux Bridge. This introduction would involve the replacement or modification of culverts under Hwy 82. The objective of this feature is to relieve elevated stages in the northern area and provide freshwater input to the brackish and intermediate marshes to the south. This feature is intended to work in concert with four other restoration feature located along the Hwy 82 alignment.

Freshwater introduction at Pecan Island

This restoration feature provides for drainage of “excess” freshwater from the Mermentau Basin Lake Subbasin across Hwy 82 near Pecan Island to the Chenier Subbasin. This introduction would involve the replacement or modification of culverts under Hwy 82. The objective of this feature is to relieve elevated stages in the northern area and provide freshwater input to the brackish and intermediate marshes to the south. This feature is intended to work in concert with four other restoration feature located along the Hwy 82 alignment.

Freshwater introduction at Rollover Bayou

This restoration feature provides for drainage of “excess” freshwater from the Mermentau Basin Lake Subbasin across Hwy 82 at Rollover Bayou to the Chenier Subbasin. This introduction would involve the replacement or modification of culverts under Hwy 82. The objective of this feature is to relieve elevated stages in the northern area and provide freshwater input to the brackish and intermediate marshes to the south. This feature is intended to work in concert with four other restoration feature located along the Hwy 82 alignment.

Freshwater Introduction at South Grand Chenier

This restoration feature provides for drainage of “excess” freshwater from the Mermentau Basin Lakes Subbasin from the Mermentau River across Hwy 82 to the Chenier Subbasin Hog Bayou watershed. This introduction would involve the replacement or modification of culverts under Hwy 82. The objective of this feature is to relieve elevated stages in the northern area and provide freshwater input to the brackish and intermediate marshes to the south. This feature is intended to work in concert with four other restoration feature located along the Hwy 82 alignment.

Stabilize Gulf shoreline near Rockefeller Refuge

This restoration feature provides for gulf shoreline stabilization from Mermentau Ship Channel to near Rollover Bayou east of Rockefeller Refuge. Stabilization methods include rock foreshore dikes, offshore reefs, or segmented breakwaters, similar to Holly Beach breakwaters, placed closer to shore and with narrower gaps. The objective of this feature is the prevention of shoreline breaching into the landward brackish and intermediate marshes.

Modify existing Cameron-Creole watershed structures

The Cameron-Creole watershed feature, constructed in 1989, consists of 5 large concrete water control structures and a 16 mile-long levee along the shoreline of Calcasieu Lake. Three of the five structures (Grand Bayou, Bois Connine Bayou, and Lambert Bayou) are adjustable structures with slide gates and the remaining two (Mangrove Bayou and No Name Bayou) are fixed crest weir structures. The fixed crest weir sill heights may be set too high. This higher setting could be contributing to the impoundment problem within Cameron-Creole marshes adjacent to those structures. If the weir sills for these two structures could be modified to lower weir crests, reduced impoundment, greater water flow, and increased fisheries access would occur independent of salinity control at Calcasieu Pass.

New Lock at the GIWW

This feature consists of a new lock at the GIWW east of Alkali Ditch with dimensions of 75 to 110 feet wide by 15 feet deep. This restoration feature would limit the exchange of water between the Sabine River and the GIWW eastward to the Calcasieu River. The existing circulation pattern provides a mechanism for the intrusion of higher salinity waters transmitted by the deeper navigation channels in each of the rivers to reach the interior marshes. The objective of the feature is the reduction of circulation of higher salinity water through the Calcasieu-Sabine sub-basin, thereby reducing future wetlands loss.

Salinity control at Alkali Ditch

This restoration feature provides salinity control at the Alkali Ditch, northwest of Hackberry at the GIWW, with a gated structure or rock weir with barge bay. The existing dimensions of the feature are approximately 150 to 200 feet wide by 8 to 10 feet deep; the structure or weir with approximate dimensions 70 feet wide by 8 feet deep. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

Salinity control at Black Bayou

This restoration feature calls for a salinity control structure with boat bay at the mouth of Black Bayou (either a gated structure or a rock weir), located at the intersection of Black Bayou and the northeastern shoreline of Sabine Lake. The existing bayou dimensions are 150 to 200 feet wide by 10 feet deep. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

Salinity control at Black Lake Bayou

This restoration feature calls for salinity control in Long Point Bayou with a gated structure or rock weir located in Long Point Bayou north of Sabine NWR near Hwy 27, west of the Calcasieu Ship Channel. The existing dimensions are 40 feet wide by 5 feet deep. The structure's approximate dimensions are 10 to 15 feet wide by 4 feet deep boat bay. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

Salinity control at Highway 82 Causeway

This restoration feature provides for a rock weir at Hwy 82 Causeway located in the southern portion of Sabine Lake north of Sabine Pass and the Sabine-Neches Waterway. Existing dimensions of the facility equal approximately 3,400 feet wide by approximately 4 feet deep, except at the approximate 10 feet deep center channel. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

Salinity control at Long Point Bayou

This restoration feature provides for salinity control in Long Point Bayou with a gated structure or rock weir located in Long Point Bayou north of Sabine NWR near Hwy 27, west of the Calcasieu Ship Channel. The existing dimensions are 40 feet wide by 5 feet deep. The structure's approximate dimensions are 10 to 15 feet wide by 4 feet deep boat bay. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

Salinity control at Oyster Bayou

This restoration feature provides for salinity control in Oyster Bayou with a gated structure or rock weir. The location in Oyster Bayou is about 1 mile west of the Calcasieu Ship Channel, which is 100 to 150 feet wide by 10 feet deep; with an approximately 15 to 20 foot wide by 4 foot deep boat bay. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

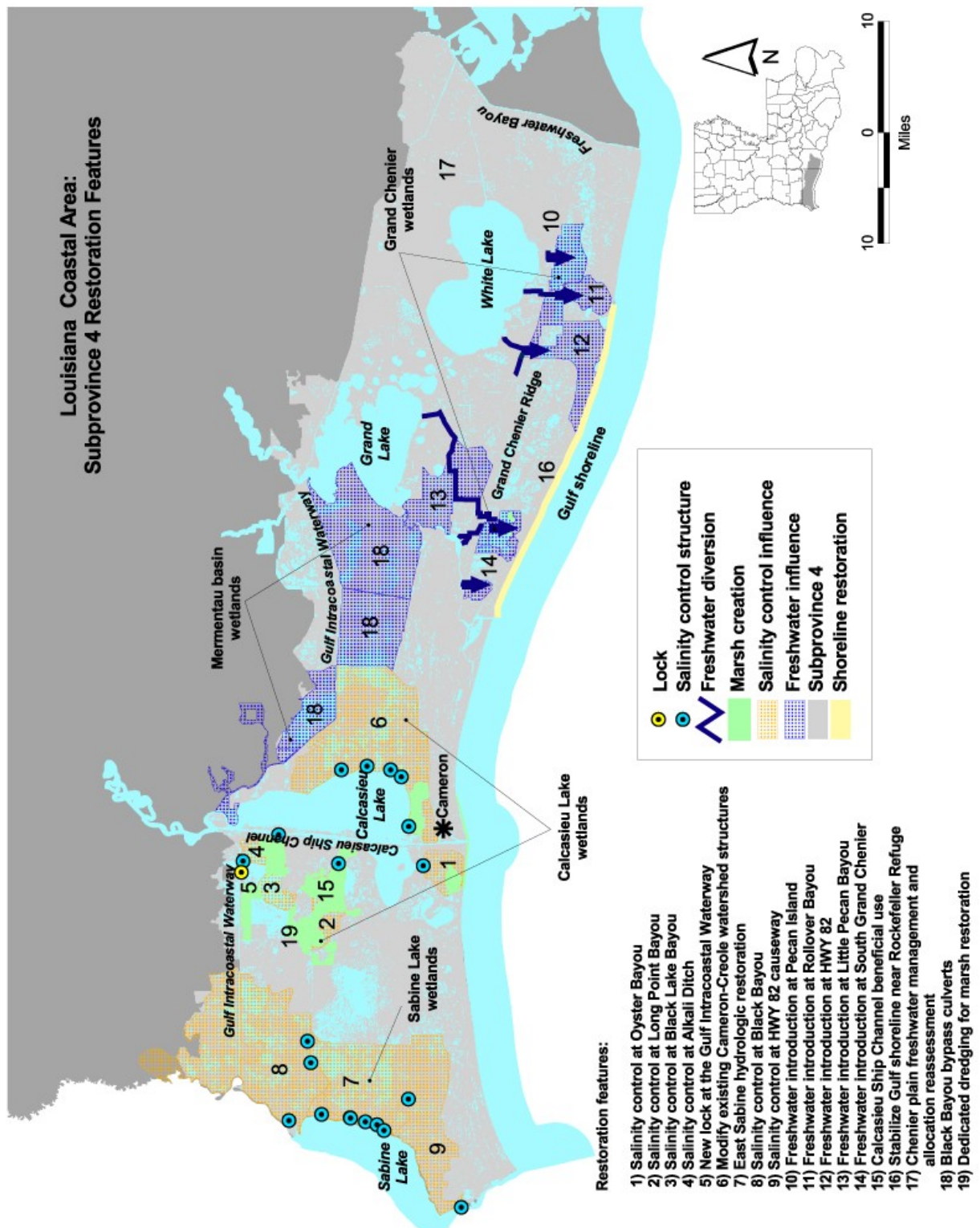


Figure E-49. Subprovince 4 Restoration Features Identified in the Final Array of Coast Wide Frameworks.

7.2 Development of Sorting and Critical Needs Criteria

The PDT determined that use of initial sorting criteria and follow-on critical needs criteria-based evaluations was an appropriate method to determine which of the 79 features would best meet near-term requirements. Criteria were developed to identify which restoration features would be placed into the various component categories described previously. In addition, the criteria helped identify the ability of each restoration feature to address critical needs.

The initial step in identifying these criteria was the gathering of input by the PDT. The Vertical Team, Framework Development Team, and the PDT developed a methodology to: 1) sort the restoration features into the component categories of the alternative LCA Plans; and 2) identify the relative value of a restoration feature in addressing critical ecologic needs in the coastal landscape. The criteria were designated as either “sorting” or “critical needs” criteria. The PDT designated three sorting criteria, and four critical need criteria.

7.2.1 Sorting criteria

7.2.1.1 Sorting Criterion #1 - Engineering and design complete and construction started within 5 to 10 years

A restoration feature would meet this criterion if, over the next 5 to 10 years:

- Required feasibility-level decision documents were completed;
- Necessary NEPA documentation were completed;
- Pre-construction engineering & design (PED) were completed; and
- Construction authorization was obtained and construction was initiated.

If a restoration feature did not meet this criterion, it was not viewed as a potential near-term restoration opportunity, but rather a potential candidate for large-scale and long-range study.

7.2.1.2 Sorting Criterion #2 - Based upon sufficient scientific and engineering understanding of processes

A restoration feature would successfully meet this criterion if it contained:

- Opportunities for which there is currently a sound understanding based in science and technology; and
- Science and engineering principles that have been applied within Louisiana and successfully achieved a beneficial ecosystem response.

Features that did not meet this criterion were not considered as potential near-term restoration opportunities. Instead, the scientific and/or engineering uncertainties associated with these restoration features provided a basis for the feature to be a potential candidate for a demonstration project.

7.2.1.3 Sorting Criterion #3 - Implementation is independent; does not require another restoration feature to be implemented first

If a feature was not deemed to be independent, other features that potentially had overlapping or duplicative effects were identified, and the interdependent features were combined. This combination of features was then reassessed to determine if, as a composite, the group of features met the initial two sorting criteria and classified appropriately.

The sorting criteria were applied sequentially. In other words, if a feature failed to meet criterion #2, then it was not reviewed to assess whether it met criterion #3. The process of applying these sorting criteria is represented in the flow diagram in **figure E-50**.

7.2.2 Critical needs criteria

If a restoration feature met all of the sorting criteria, it was then assessed against the critical needs criteria. The application of the criteria was done in an annotated manner so that the reasoning for applicability of each feature versus the criteria could be readily assessed. This approach allowed the PDT to make relative comparisons of different features based on common criteria and fine tune the overall value of features in addressing the critical ecologic and human needs of the system. The following criteria were applied to potential near-term course of action features as defined.

7.2.2.1 Critical Needs Criterion #1 - Prevents future land loss where predicted to occur

One of the most fundamental drivers of ecosystem degradation in coastal Louisiana has been the conversion of land (mostly emergent vegetated wetland habitat) to open water. One of the most fundamental critical needs is to stem this loss. Thus, the projection of the future condition of the ecosystem must be based upon the determination of future patterns of land and water. Future patterns of land loss were based on the USGS open file report 03-334 “Historical and Predicted Coastal Louisiana Land Changes: 1978-2050” (appendix B HISTORIC AND PROJECTED COASTAL LOUISIANA LAND CHANGES: 1978-2050). This also applies to future predicted conversion of cypress swamp in areas with existing fragmenting marsh.

7.2.2.2 Critical Needs Criterion #2 - (Sustainability) Restores fundamentally impaired (or mimics) deltaic function through river reintroductions

This criterion refers to opportunities that would restore or mimic natural connections between the river and the basins (or estuaries), including distributary flows, crevasses, and over-bank flow. Mechanical marsh creation with river sediment was also viewed as mimicking the deltaic function of sediment introduction if supported by sustainable freshwater and nutrient reintroduction.

7.2.2.3 Critical Needs Criterion #3 - (Sustainability) Restores or preserves endangered critical geomorphic structure

This criterion identifies opportunities that would restore or maintain natural geomorphic structures such as barrier islands, distributary ridges, cheniers, land bridges, and beach and lake rims. These geomorphic structures are essential to maintaining the integrity of coastal ecosystems. Those structures that are endangered or “nearly lost” in the near-term are especially critical.

7.2.2.4 Critical Needs Criterion #4 - Protects vital socio-economic resources

This criterion identifies proposed opportunities that would potentially protect vital local, regional, and national social, economic, and cultural resources. These resources include cultures, community, infrastructure, business and industry, and flood protection.

7.2.3 Application of the criteria

Following the identification of these restoration criteria and the method for their application, the PDT made an initial assessment of the 79 restoration features. This assessment indicated that the methodology could be applied effectively to identify potential alternative plans.

During the week of April 19 to 23, 2004, a series of public scoping meetings were held across the LCA Study area. These meetings provided the public and stakeholder groups an opportunity to comment on the modification of the study and the specific criteria for identifying alternative LCA Plans. The participants were provided with an overview of the criteria and methodology, the written definition of each criterion’s application, and a list of the 79 features. This information was also made available on the study’s web site along with additional feature details. The meeting participants were encouraged to comment on and/or modify the criteria and methodology developed by the PDT, as well as to provide input on additional criteria that they considered appropriate. Finally, attendees were encouraged to take materials to other interested parties who were not able to attend or direct them to the study’s web site to submit their comments.

The public input was compiled and used to make adjustments to the criteria or to the criteria’s application to individual features. In addition, public input allowed the PDT to make final assessments of the appropriate components of the alternative LCA Plans.

7.2.4 Development and evaluation of alternative plans

As detailed previously, application of the three sorting criteria and four critical needs criteria was the basis for development of alternative plans composed of near-term critical features, candidate large-scale studies, and candidate science and technology demonstration projects. The sorting criteria application that determined what were the possible near-term critical features among the 79 initial features was considered fixed. The best opportunity to develop alternative plans resided in the application of the critical needs criteria to determine the near-term critical features. While each of the critical needs criteria were supporting and complimentary, it was possible to discern alternative combinations of near-term critical features by applying the criteria individually or in varying combinations.

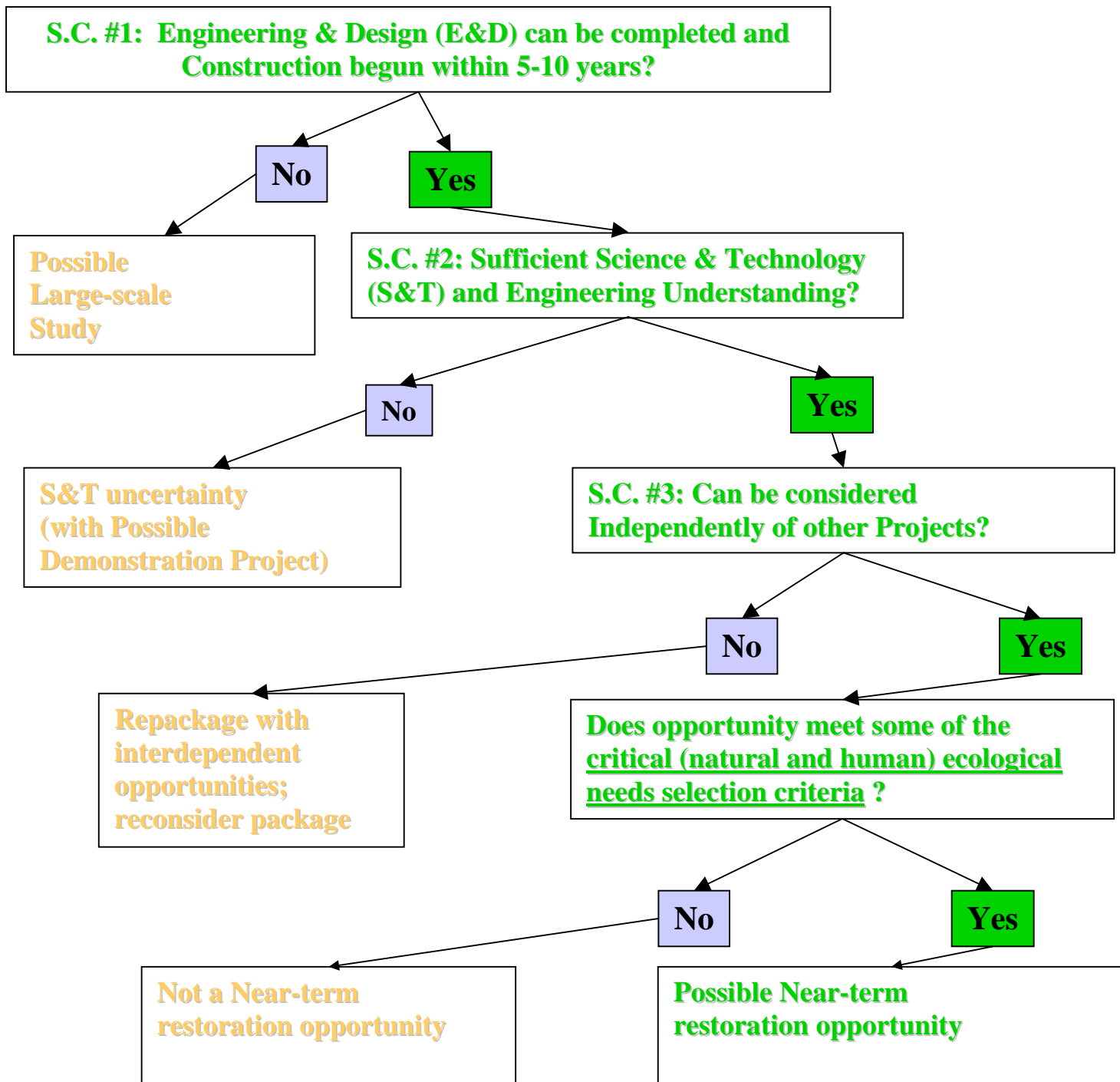


Figure E-50. LCA Sorting Process Flow Diagram.

7.3 Sorting Criteria Application Results

During Phase VI, each of the 79 restoration features was analyzed through the three Sorting Criteria (**figure E-50**) and four Critical Needs Criteria. These criteria were designed to determine whether or not a restoration feature should be incorporated as a near-term component in one or more of the LCA alternative plans. In addition, if it was determined that a feature was to be included in the near-term course of action, the criteria helped determine in which component category it would best fit. For example a restoration feature could represent a potential near-term critical restoration feature or a potential large-scale study for a promising restoration concept. Alternatively, an overarching scientific or technological uncertainty could be associated with a restoration feature that would first require the development and implementation of an appropriately scaled demonstration project prior to the implementation of the feature.

7.3.1 Results of Applying Sorting Criterion #1: Engineering and Design (E&D) can be Completed and Construction Started within 5 to 10 Years

Application of Sorting Criterion #1 winnowed down the number of potential restoration features from 79 to 61. Those restoration features deemed too complex to have feasibility-level decision documents complete and construction begun within the next 5 to 10 years of plan implementation did not successfully pass through this sorting criterion and were instead considered for inclusion in the LCA Plan alternatives as potential large-scale studies. **Table E-46** lists those restoration features that did not meet Sorting Criterion #1 and were, therefore eliminated from further consideration as near-term plan restoration features.

Table E-46. Restoration Features Eliminated using Sorting Criterion #1: Features Whose E&D Could not be Completed and Construction Started Within the Next 5 to 10 Years

Subprovince 1

- Medium diversion at Bonnet Carre Spillway
- Post authorization for the diversion of water through Inner Harbor Navigation Canal for enhanced influence into Central Wetlands
- Medium to large sediment diversion at American/California Bays
- Mississippi River Delta Management Study (Subprovinces 1 & 2)

Subprovince 2

- Medium diversion at Edgard with sediment enrichment
- Large diversion at Boothville with sediment enrichment
- Medium diversion at Fort Jackson - Alternative to Boothville diversion
- Large diversion at Fort Jackson with sediment enrichment - Alternative to Boothville diversion
- Medium diversion at Lac Des Allemands with sediment enrichment
- Large diversion at Myrtle Grove with sediment enrichment
- Third Delta (Subprovinces 2 & 3)

Subprovince 3

- Relocate the Atchafalaya Navigation Channel
- Increase sediment transport down Wax Lake Outlet
- Alternative operational scheme of the Old River Control Structure (ORCS)
- Acadiana Bay Estuarine Restoration
- Rebuild historic reefs - Rebuild historic barrier between Point Au Fer and Eugene Island and construct segmented reef/breakwater/jetty along the historic Point Au Fer barrier reef from Eugene Island extending towards Marsh Island to the west

Subprovince 4

- Chenier Plain freshwater management and allocation reassessment*
 - Freshwater introduction at South Grand Chenier
 - Freshwater introduction at Pecan Island
 - Freshwater introduction at Rollover Bayou
 - Freshwater introduction at Highway 82
 - Freshwater introduction at Little Pecan Bayou
- New lock at the GIWW

* These features did not pass Sorting Criterion #3, were repackaged and are considered as a potential large-scale study within the Chenier Plain Freshwater Management and Allocation Study

7.3.2 Results of Applying Sorting Criterion #2: Sufficient S&T and Engineering Understanding of Processes

Of the 61 features that met Sorting Criterion #1, 27 did not successfully meet Sorting Criterion #2 because they contained some form of scientific or technical uncertainty that would require resolution prior to their implementation. The various types of uncertainties are described in section 3.1 PLANNING CONSTRAINTS. These uncertainties may be resolved by the development and implementation of an appropriately scaled demonstration project (the specific features may suggest demonstration project locations). **Table E-47** lists features that did not meet Sorting Criterion #2 and were, therefore eliminated from further consideration as near-term course of action restoration features.

Table E-47. Restoration Features Eliminated Using Sorting Criterion #2: Features Having Significant Uncertainties About Science and Technology and Engineering Understanding of Processes.

Subprovince 1

- Marsh nourishment on New Orleans East land bridge
- Sediment delivery via pipeline at La Branche wetlands
- Sediment delivery via pipeline at American/California Bays
- Sediment delivery via pipeline at Central Wetlands
- Sediment delivery via pipeline at Ft. St. Philip
- Sediment delivery via pipeline at Golden Triangle
- Sediment delivery via pipeline at Quarantine Bay
- Opportunistic use of Bonnet Carre Spillway (CWPPRA project)

Subprovince 2

- Implement the LCA Barataria Basin Wetland Creation and Restoration Study
- Sediment delivery via pipeline at Bastian Bay/Buras
- Sediment delivery via pipeline at Empire
- Sediment delivery via pipeline at Main Pass (Head of Passes)

Subprovince 3

- *Maintain land bridge between Bayous du Large and Grand Caillou*
- Maintain Timbalier land bridge
- Backfill pipeline canals
- Freshwater introduction south of Lake De Cade

Subprovince 4

- Salinity control at Alkali Ditch
- Salinity control at Highway 82 Causeway
- Salinity control at Oyster Bayou
- Salinity control at Long Point Bayou
- Salinity control at Black Lake Bayou
- Black Bayou Bypass culverts
- Dedicated dredging for marsh restoration
- Stabilize Gulf shoreline near Rockefeller Refuge
- Modify existing Cameron-Creole watershed structures
- East Sabine Lake hydrologic restoration
- Salinity control at Black Bayou

7.3.3 Results of Applying Sorting Criterion #3: Implementation is Independant; Does not Require Other Restoration Feature to be Implemented First

The remaining 34 features were next subjected to Sorting Criterion #3 to determine their independence from other restoration features. When running these remaining features through Sorting Criterion #3, 13 features were deemed to be independent (received a “Yes” for this criterion). These 13 features then proceeded to the Critical Needs Criteria evaluation. The 21 features that were determined to be interdependent (received a “No” for this criterion) were combined with other dependent features(s), as appropriate, to create “restoration opportunities”. The combined restoration opportunities were evaluated again using Sorting Criteria 1, 2, and 3. One of the restoration opportunities, Freshwater Reintroductions into Subprovince 4, (consisting of five features) failed to pass Sorting Criterion #1 and was reserved as a potential concept for large-scale studies and eliminated from consideration as a near-term restoration opportunity. The remaining 6 restoration opportunities (consisting of 16 features) passed both criteria 1 and 2 and were included for further consideration as near-term restoration opportunities. **Table E-48** identifies the 13 restoration features and 6 combined restoration opportunities (made up of 16 restoration features) that were further evaluated using the Critical Needs Criteria. **Figure E-51** provides a graphic representation of the Sorting Criteria Evaluation Process.

**Table E-48 –Restoration Features and
Restoration Opportunities that Passed Sorting Criteria 1 to 3:**

Subprovince 1

- MRGO Environmental Restoration Features
- Maurepas Swamp Reintroductions Restoration Opportunity
This restoration opportunity includes the following features:
 - Small diversion at Hope Canal (CWPPRA Maurepas Diversion)
 - Small diversion at Convent / Blind River
 - Increase Amite River Diversion Canal influence by gapping banks
- Upper Breton Sound Reintroductions Restoration Opportunity
This restoration opportunity includes the following features:
 - Modification of Caernarvon diversion
 - Medium diversion at White's Ditch
- Lower Breton Sound Reintroductions Restoration Opportunity
This restoration opportunity includes the following features:
 - Rehabilitate Bayou Lamoque structure as a medium diversion
 - Medium diversion at American / California Bays
- Rehabilitate Violet Siphon for enhanced influence to Central Wetlands
- Medium diversion at Fort St. Philip

Subprovince 2

- Barataria Basin barrier shoreline restoration
- Mid-Barataria Basin Reintroductions Restoration Opportunity
This restoration opportunity includes the following features:
 - Modification of Davis Pond diversion for increased sediment input
 - Medium diversion with dedicated dredging at Myrtle Grove
- Lac Des Allemands Area Reintroductions Restoration Opportunity
This restoration opportunity includes the following features:
 - Small diversion at Lac Des Allemands
 - Small diversion at Donaldsonville
 - Small diversion at Pikes Peak
 - Small diversion at Edgard

Subprovince 3

- Small Bayou Lafourche reintroduction
- Terrebonne Marsh Restoration Opportunity
This restoration opportunity includes the following features:
 - Optimize flows and Atchafalaya River influence in Penchant Basin
 - Multi-purpose operation of Houma Navigation Canal (HNC) Lock
 - Convey Atchafalaya River water to Terrebonne Marshes via a small diversion in the Avoca Island Levee, repairing eroding banks of the GIWW, and enlarging constrictions in the GIWW below Gibson and in Houma, and Grand Bayou conveyance channel construction / enlargement
- Terrebonne Basin barrier shoreline restoration

- Maintain land bridge between Caillou Lake and Gulf of Mexico
- Gulf shoreline stabilization at Point Au Fer Island
- Maintain northern shore of East Cote Blanche Bay at Point Marone
- Rehabilitate Northern Shorelines of Terrebonne / Timbalier Bays
- Stabilize banks of Southwest Pass
- Freshwater introduction via Blue Hammock Bayou

Subprovince 4

- Calcasieu Ship Channel Beneficial Use

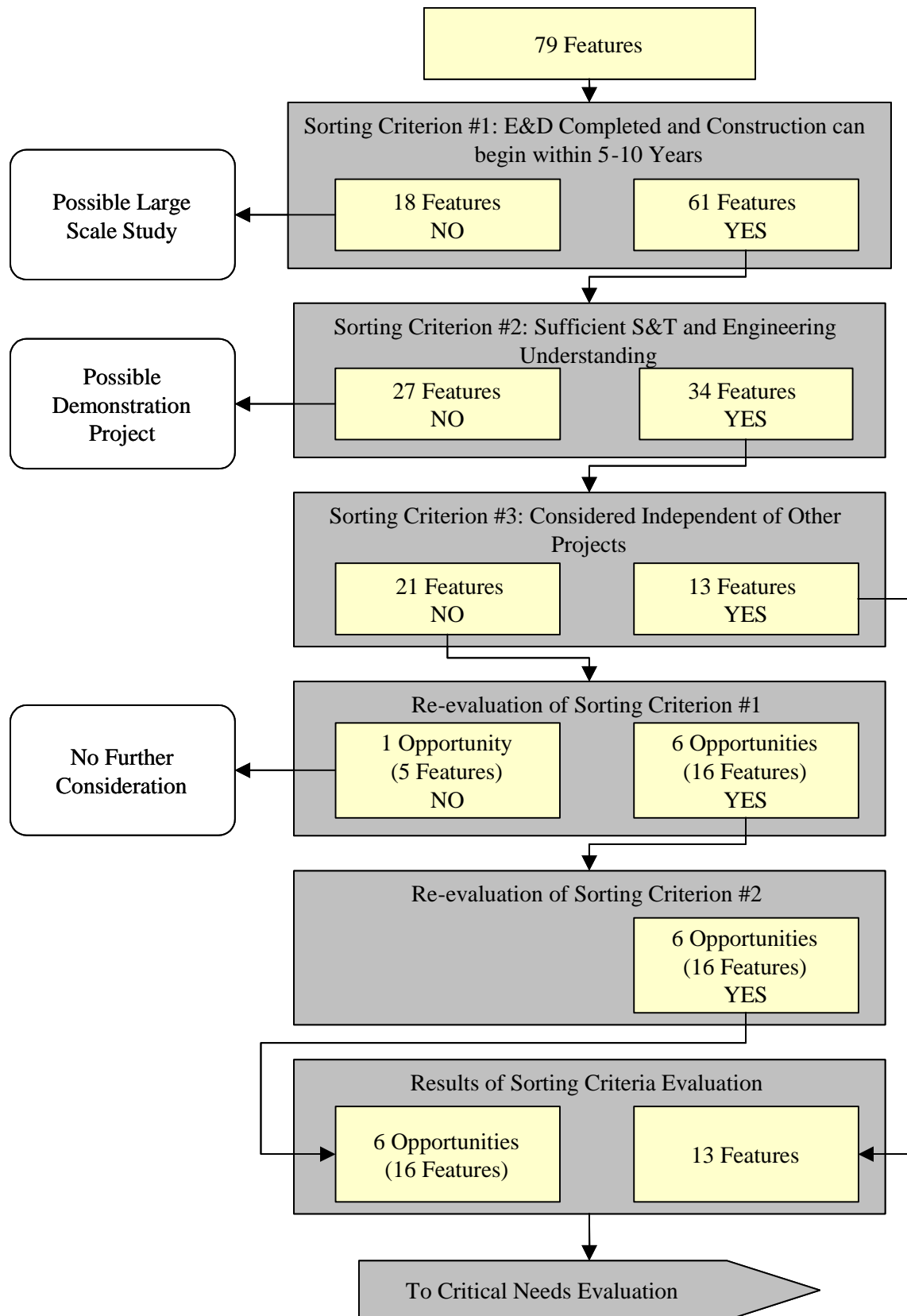


Figure E-51. Application of Sorting Criteria to Restoration Features and Opportunities.

7.4 Critical Needs Criteria Application Results

Following the application of Sorting Criteria, the 13 restoration features and 6 restoration opportunities (made up of 16 restoration features) were further evaluated using the Critical Needs Criteria. Annotated comments were developed for each feature and opportunity to identify the particular Critical Need Criteria that a component met (or did not meet), as well as the relative ability of the feature or opportunity to address them. After evaluating the 13 features and 6 restoration opportunities using the Critical Needs Criteria, 7 features and 5 restoration opportunities (made up of 14 restoration features) were determined to meet the Critical Needs Criteria. These features and opportunities were used to form the basis of the alternative near-term courses of action. Alternately, 6 features and 1 restoration opportunity (made up of 2 restoration features) did not meet the Critical Needs Criteria, and were not considered for inclusion in the near-term course of action. Below are the annotated comments of the results of the assessment of individual features and restoration opportunities following application of the four Critical Needs Criteria.

7.4.1 Features Having Significant “Critical Needs Criteria” Value

7.4.1.1 Subprovince 1

MRGO Environmental Restoration Feature

This feature addresses Critical Needs Criteria 1, 3, and 4. Specifically, this feature has the potential to: prevent predicted future land loss and restore previously degraded wetlands; stabilize and restore the endangered, critical lake rim geomorphic structure; and protect vital socio-economic resources, such as developments located adjacent to the confluence of the MRGO with the GIWW.

Maurepas Swamp Reintroductions Opportunity

The Maurepas Swamp Reintroduction Opportunity includes the following features:

- Small diversion at Hope Canal (CWPPRA Maurepas Diversion)
- Small diversion at Convent / Blind River
- Increase Amite River Diversion Canal influence by gapping banks

This near-term restoration opportunity evaluates several features that have the potential to address Critical Needs Criteria 1, 2, and 4. Specifically, this opportunity has the potential to: prevent future cypress swamp degradation and transition currently predicted to occur; restore the deltaic process impaired by levee and dredged material bank construction; and protect vital socio-economic and public resources, such as the growing eco-tourism industry resident in the Maurepas Swamp and the Maurepas Wildlife Management Area.

Upper Breton Sound Reintroductions Opportunity

The Upper Breton Sound Reintroduction Opportunity includes the following features:

- Modification of Caernarvon diversion
- Medium diversion at White's Ditch

This near-term restoration opportunity evaluates several features that have the potential to address Critical Needs Criteria 2 and 4. Specifically, this opportunity has the potential to restore the deltaic process impaired by levee construction at locations where historic crevassing has occurred and protect vital socio-economic resources located in areas along the east bank of the Mississippi River in Plaquemines Parish within hurricane flood protection levees. This opportunity also includes features that capitalize on existing structures, such as the Caernarvon diversion.

7.4.1.2 Subprovince 2

Barataria Basin Barrier Shoreline Restoration Feature

This restoration feature has multiple components, some of which have potential to address Critical Needs Criteria 1, 3, and 4. Specifically, this feature has the potential to: preventing major future land loss where currently predicted to occur; restoring endangered, critical geomorphic structure at the gulfward boundary of the Barataria system; and protecting vital socio-economic resources, such as oil and gas infrastructure located on the leeward side of these islands. However, this feature entails some aspects of technical uncertainty in the availability and quality of source material, delivery material by pipeline, and durability.

Mid-Barataria Basin Reintroductions Opportunity

The Mid-Barataria Basin Reintroduction Opportunity includes the following features:

- Modification of Davis Pond diversion for increased sediment input
- Medium diversion with dedicated dredging at Myrtle Grove

This near-term restoration opportunity evaluates several features that have the potential to address Critical Needs Criteria 1, 2, and 4. Specifically, this opportunity has the potential to: prevent significant future land loss where currently predicted to occur; restore the deltaic process impaired by the construction of levees at locations where historic crevassing has occurred, as well as improve water quality; and protect vital socio-economic resources located in the central and upper portions of the Barataria Basin. This opportunity would also capitalize on the existing Davis Pond diversion structure.

Lac Des Allemands Area Reintroductions Opportunity

The Lac Des Allemands Area Reintroductions Opportunity includes the following features:

- Small diversion at Lac Des Allemands
- Small diversion at Donaldsonville
- Small diversion at Pikes Peak
- Small diversion at Edgard

This near-term restoration opportunity evaluates several features that have the potential to address Critical Needs Criteria 1, 2, and 4. Specifically, this opportunity has the potential to: prevent significant future land loss where currently predicted to occur; restore the deltaic process impaired by levee construction in areas where historic crevassing has occurred; and protect vital socio-economic resources such as the eco-tourism industry and residents in the upper Barataria Basin.

7.4.1.3 Subprovince 3

Small Bayou Lafourche Reintroduction Feature

This feature would reintroduce flow from the Mississippi River into Bayou Lafourche and addresses Critical Needs Criteria 1, 2, and 4. Specifically, this feature has the potential to: prevent future land loss where predicted to occur; restore a fundamentally impaired deltaic process by reintroducing water to a historic distributary of the Mississippi; and protect vital community and socioeconomic resources by supplementing channel flow and stabilizing water quality.

Terrebonne Basin Barrier Shoreline Restoration Feature

This restoration feature has multiple components, some of which have potential to address Critical Needs Criteria 1, 3, and 4. Specifically, this feature has the potential to: prevent future barrier island losses where predicted to occur; restore endangered, critical geomorphic structure; and protect vital socio-economic resources such as oil and gas infrastructure and fisheries. However, this feature entails some aspects of technical uncertainty in the availability and quality of source material, delivery of material by pipeline, and durability.

Maintain Land Bridge Between Caillou Lake and Gulf of Mexico Feature

This restoration feature addresses Critical Needs Criteria 1 and 3. This feature would stem shoreline retreat and prevent further breaches that have allowed increased water exchange between the gulf and the interior water bodies (between Bay Junop and Caillou Lake). Prevention of increased marine influence would reduce interior wetland loss as well as preserve the potential for long-range restoration. Closure of newly opened channels would restore historic cross-sections of exchange points, would reduce marine influences in interior areas, and allow increased freshwater influence from Four League Bay to benefit area marshes.

Gulf Shoreline Stabilization at Point Au Fer Island Feature

This feature addresses Critical Needs Criteria 1, 3, and 4. Specifically, this feature has the potential to: prevent future shoreline retreat where predicted to occur; restore endangered, critical geomorphic structure by stabilizing the island shoreline; and protect vital community and socio-economic resources.

Terrebonne Marsh Restoration Opportunity

The Terrebonne Marsh Restoration Opportunity includes the following features:

- Optimize flows and Atchafalaya River influence in Penchant Basin
- Multi-purpose operation of Houma Navigation Canal (HNC) Lock
- Convey Atchafalaya River water to Terrebonne Marshes via a small diversion in the Avoca Island levee, repairing eroding banks of the GIWW, and enlarging

constrictions in the GIWW below Gibson and in Houma, and Grand Bayou conveyance channel construction/enlargement

This near-term restoration opportunity evaluates several features that have the potential to address Critical Needs Criteria 1, 2, and 4. Specifically, this opportunity has the potential to: prevent future land loss where predicted to occur; restore fundamentally impaired deltaic processes through the re-introduction of Atchafalaya River water; and protect vital community and socio-economic resources in the area, such as waterborne commerce and oil and gas infrastructure.

7.4.1.4 Subprovince 4

Calcasieu Ship Channel Beneficial Use Feature

This feature addresses Critical Needs Criteria 1 and 4. Specifically, this feature has the potential to prevent future land loss where predicted to occur and protect vital community and socio-economic resources of agricultural land use and oil and gas infrastructure. It also capitalizes on the existing navigation maintenance activity.

7.4.2 Features and Opportunities Having Limited or No “Critical Needs Criteria” Value

7.4.2.1 Subprovince 1

Lower Breton Sound Reintroductions Opportunity

The Lower Breton Sound Reintroductions Opportunity includes the following features:

- Rehabilitate Bayou Lamoque structure as a medium diversion
- Medium diversion at American/California Bays

This near-term restoration opportunity evaluates two features that have the potential to address Critical Needs Criteria 2 and 4. This opportunity also includes features that capitalize on existing structures, such as the Bayou Lamoque diversion. While this opportunity has some limited potential to restore the deltaic process in locations where historic crevassing has occurred, the proposed scale does not afford a significant influence on the critical need in the area. As a result, this opportunity was not included in any alternative plans.

Rehabilitate Violet Siphon for Enhanced Influence to Central Wetlands Feature

This feature has some effectiveness meeting Critical Needs Criteria 1 and 2. However, the existing structure has currently been rehabilitated and is operating to capacity on a regulated schedule. Therefore, this feature was not included in any alternative plans.

Medium Diversion at Fort St. Philip Feature

This feature has limited impact meeting Critical Needs Criterion #2. Specifically, this feature appears to have some limited potential to restore deltaic process in the area. However, the major ecologic need in the area is the introduction of large volumes of sediment. The assessment of this feature was that it fell low in the priority of possible critical near-term actions and was therefore not included in any alternative plans.

7.4.2.2 Subprovince 3

Maintain Northern Shore of East Cote Blanche Bay at Point Marone Feature

This feature addresses Critical Needs Criteria 1 and 3 to a minor extent. Specifically, this feature has the potential to prevent some limited future shoreline retreat where predicted to occur and restore some geomorphic structure by stabilizing a small portion of this bay shoreline. The assessment of this feature was that it fell low in the priority of possible critical near-term actions and was therefore not included in any alternative plans.

Rehabilitate Northern Shorelines of Terrebonne/Timbalier Bays Feature

This feature addresses Critical Needs Criteria 1 and 4. Specifically, this feature has the potential to prevent future shoreline retreat where predicted to occur and protect vital community and socio-economic resources. This feature potentially duplicates the effects of the Terrebonne Basin Barrier-shoreline Restoration feature. The assessment of this feature is that in the near-term the immediate stabilization of the existing barrier-shoreline features is a more effective option. While this feature could be investigated in conjunction with the barrier-shoreline feature, it was not included in any alternative plans.

Stabilize Banks of Southwest Pass Feature

While qualifying, with some effect relative to critical needs criteria, this feature does not appear to produce significant enough changes in the ecosystem to include it any alternative plans. The feature may be further investigated in conjunction with the large-scale Acadiana Bays Estuarine Restoration Study.

Freshwater Introduction via Blue Hammock Bayou Feature

While qualifying, with some effect relative to critical needs criteria, as near-term this feature it does not appear to produce significant enough changes in the ecosystem to include it any alternative plans.

7.5 Alternative Plan Evaluation Results

Table E-49 presents the 15 Alternative Plans (plus the No Action Alternative), provides the corresponding plan name (represented by the letters A – O), and identifies which Critical Needs Criterion/Criteria each specific alternative strived to meet. For example, Alternative Plans A, B, D, and H all focus on meeting one of the Critical Needs Criteria (1 through 4 respectively). The remaining 11 Alternative Plans were formulated to include all remaining possible mathematical combinations of the 4 Critical Needs Criteria.

Table E-49. Possible Alternative Plans and Associated Responsiveness to the Critical Needs Criteria.

Alternative Plan	Criterion 1 (Prevent Future Land Loss)	Criterion 2 (Riverine Reintroductions)	Criterion 3 (Restore Geomorphic Structure)	Criterion 4 (Protects Vital community & socio-economic resources)
A	X			
B		X		
C	X	X		
D			X	
E	X		X	
F	X	X	X	
G		X	X	
H				X
I	X			X
J		X		X
K	X	X		X
L	X		X	X
M			X	X
N	X	X	X	X
O		X	X	X
P (No Action)				

Using the annotated comments that resulted from the Critical Needs Criteria evaluation process, specifically the consensus opinion on which Critical Needs Criteria a restoration feature or opportunity best addresses, the PDT populated each of the 15 alternative plans with the restoration features and opportunities that successfully passed through both Screening and Critical Needs Criteria. For example, Alternative A includes all viable restoration features and opportunities that address Critical Needs Criteria 1 (preventing future land loss). Continuing the example, Alternative C is comprised of all viable restoration features and opportunities that address both Critical Needs Criteria 1 and 2 (prevent future land loss and utilizing riverine reintroductions). A summary restoration features restoration opportunities included in each of the 15 alternative plans is detailed in **table E-50**.

Table E-50 Alternative Plan Make-up

		Alternative Plans														
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Restoration Feature or Opportunity	MRGO Environmental Restoration Features	X		X	X	X	X	X	X	X	X	X	X	X	X	X
	Maurepas Swamp Reintroduction Opportunities	X	X	X		X	X	X	X	X	X	X	X	X	X	X
	Barataria Basin Barrier Shoreline Restoration	X		X	X	X	X	X	X	X	X	X	X	X	X	X
	Small Bayou Lafourche Reintroduction	X	X	X		X	X	X	X	X	X	X	X	X	X	X
	Mid-Barataria Basin Reintroduction Opportunity	X	X	X		X	X	X	X	X	X	X	X	X	X	X
	Upper Breton Sound Reintroduction Opportunity		X	X			X	X	X	X	X	X	X	X	X	X
	Calcasieu Ship Channel Beneficial Use	X		X	X	X	X	X		X		X	X	X	X	X
	Terrebonne Marsh Restoration Opportunity	X	X	X		X	X	X	X	X	X	X	X	X	X	X
	Terrebone Basin Barrier Shoreline Restoration	X		X	X	X	X	X	X	X	X	X	X	X	X	X
	Maintain Land Bridge Between Caillou Lake and Gulf of Mexico	X		X	X	X	X	X		X		X	X	X	X	X
	Gulf Shoreline Stabilization at Point Au Fer Island	X		X	X	X	X	X	X	X	X	X	X	X	X	X
	Las Des Allemands Area Reintroductions Opportunity	X	X	X		X	X	X		X	X	X	X		X	X

Evaluation of the 15 alternatives was based on the identification of significantly different alternative plans to meet the study objectives and Critical Needs Criteria. As **table E-50** clearly shows, all of the restoration features and measures available to make up the suite of alternative plans were found in more than one Alternative Plan. This is due to the fact that all available restoration features and measures met multiple Critical Needs Criteria. For example, the MRGO Environmental Restoration Feature met Critical Needs Criteria 1, 3, and 4. Because of this, the process of identifying and delineating significantly different alternative plans was one in which the 15 alternative plans underwent intense scrutiny. A discussion of the composition of, and similarities and differences between, alternative plans follows.

7.5.1 Alternative Plans Designed to Meet Only 1 Critical Needs Criterion

Alternative A (the independent application of Critical Needs Criterion #1 (*prevention of predicted land loss*)), resulted in a plan combination that excluded diversions in the Breton Sound Basin, but was inclusive of all other potential near-term features and opportunities. As such, Alternative A was grouped into the numerous alternative plans that sought to meet multiple Critical Needs Criteria.

Alternative B (the independent application of Critical Needs Criterion #2 (*sustainability through restored deltaic function*), also produced broad inclusion of potential features and opportunities, but uniformly excluded all barrier shoreline and marsh creation through dredged material use features. Alternative B also excluded any near-term opportunities in the Chenier Plain. However, this alternative was significantly different from the other 15 alternatives, and was carried forward for further evaluation.

Alternative D (the independent application of Critical Needs Criterion #3 (*sustainability through restoration of geomorphic structure*), produced a combination of features and opportunities focused on barrier shoreline restoration and direct land building focused on maintaining a protective structure. However, this alternative was significantly different from the other 15 alternatives, and was carried forward for further evaluation.

Alternative H (the independent application of Critical Needs Criterion #4 (*protection of vital socio-economic resources*), resulted in a diverse combination of features and opportunities that excluded restoration features and opportunities that did not directly benefit infrastructure or property. However, inclusion of Critical Needs Criterion #4 with any other criteria also provided a minor supplemental effect to most other possible alternative combinations. The absence of Critical Needs Criterion #4, in combination with any other criteria, results in only 2 to 3 feature or opportunity exclusions in any of those plans. In addition, Critical Needs Criterion #4, while defining a critical outcome of coastal restoration, could be more appropriately viewed as a synergistic factor in comparison to the critical needs for direct physical restoration of the landscape. As a result, it was determined that the independent application of criterion #4 did not produce a viable alternative plan. Therefore, Alternative H was not considered as a viable alternative plan.

7.5.2 Alternative Plans Designed to Meet Multiple Critical Need Criteria

Alternative plans seeking to meet multiple Critical Needs Criteria, particularly those that included Critical Needs Criterion #2, quickly reached full inclusion of all or nearly all the potential restoration features and opportunities. Three of the Alternative Plans (Alternatives E, J, and M), while intending to focus on meeting different Critical Needs Criteria, were comprised of almost the same restoration features and opportunities (+/- 4 features/opportunities). Likewise, eight of the Alternative Plans (Alternatives C, F, G, I, K, L, N, and O) had the exact same make-up i.e., they included all potential restoration features and opportunities. These 11 alternative plans were therefore grouped because, due to their similarity, they did not provide a true alternative choice (they were not significantly different). For the purpose of continued alternative plan evaluation, these 11 alternatives, and Alternative A described previously, were grouped and represented by Alternative Plan N because its inclusion of all potential restoration features and opportunities was an outcome of its design to meet all four Critical Needs Criteria.

7.5.3 Comparison of Alternative Plans

Summarizing the analysis results detailed above, three significantly different alternatives (Alternative Plans B, D, and N) arose. A comparison of the restoration features and opportunities, and construction costs estimates for these three alternative plans is provided in **table E-51**.

Table E-51. Comparison of Alternative Plan Feature Combinations and Construction Costs.

Potential Near-term Features	Alternative Near-term Plans		
	B	D	N
Mississippi River Gulf Outlet Environmental Restoration Features		\$80,000,000	\$80,000,000
<u>Maurepas Swamp Reintroductions</u> --			
Small Diversion at Convent / Blind River	\$28,564,000		\$28,564,000
Small Diversion at Hope Canal	\$30,025,000		\$30,025,000
Amite River Diversion (spoil bank gapping)	\$2,855,000		\$2,855,000
Barataria Basin Barrier Shoreline Restoration -- Caminada Headland, Shell Island		\$181,000,000	\$181,000,000
Small Bayou Lafourche Reintroduction	\$90,000,000		\$90,000,000
Medium Diversion with Dedicated Dredging at Myrtle Grove	\$146,700,000		\$146,700,000
Calcasieu Ship Channel Beneficial Use of Dredged Material		\$100,000,000	\$100,000,000
Modification of Caernarvon Diversion for Marsh Creation	\$1,800,000		\$1,800,000
Modification Davis Pond Diversion for Marsh Creation	\$1,800,000		\$1,800,000
<u>Terrebonne Marsh Restoration Opportunities</u> --			
Optimize Flows & Atchafalaya River Influence in Penchant Baisn	\$9,720,000		\$9,720,000
Multi-purpose Operation of the Houma Navigation Canal (HNC) Lock	\$0		\$0
Convey Atchafalaya River Water to Northern Terrebonne Marshes	\$132,200,000		\$132,200,000
Terrebonne barrier shoreline restoration -- Isle Derniere, E. Timbalier		\$84,850,000	\$84,850,000
Maintain Land Bridge between Caillou Lake and Gulf of Mexico.		\$41,000,000	\$41,000,000
Medium Freshwater Diversion at White's Ditch	\$35,200,000		\$35,200,000
Stabilize Gulf Shoreline at Point Au Fer Island		\$32,000,000	\$32,000,000
<u>Lac des Allemands area Reintroductions</u> --			
Small Diversion at Lac des Allemands	\$17,330,000		\$17,330,000
Small Diversion at Donaldsonville	\$16,670,000		\$16,670,000
Small Diversion at Pikes Peak	\$12,940,000		\$12,940,000
Small Diversion at Edgard	\$13,100,000		\$13,100,000
Total Near-term Plan Construction Cost	\$538,904,000	\$518,850,000	\$1,057,754,000

Alternative Plan B focused on restoration of deltaic processes (Critical Needs Criterion #2), and included 15 restoration near-term features and opportunities, all with combinations of river diversion features. Alternative Plan B exhibits some shortcomings because it does not address critical geomorphic structures. Alternative Plan D focused on restoration of geomorphic structure (Critical Needs Criterion #3), and included 11 restoration features and opportunities including shoreline protection, barrier island restoration, and marsh creation. Alternative Plan D exhibits some shortcomings because it does not address the river reintroductions. The body of knowledge concerning application of coastal restoration strategies in Louisiana suggests that while Alternative Plans B and D would have significant environmental benefits, they each exhibit some weaknesses in addressing the complete range of study planning objectives and Critical Needs Criteria.

Conversely, Alternative Plan N encompasses all four Critical Needs Criteria and exhibits potential for long-term sustainability because it contains the geomorphic structures which serve to protect and buffer the diversion feature influence areas from erosive coastal wave action and storm surge. Additionally, river diversion features are more sustainable because they are continuously connected to the river resource and nourished by its sediment and nutrients. **Figure E-52** provides a graphical representation of this discussion.

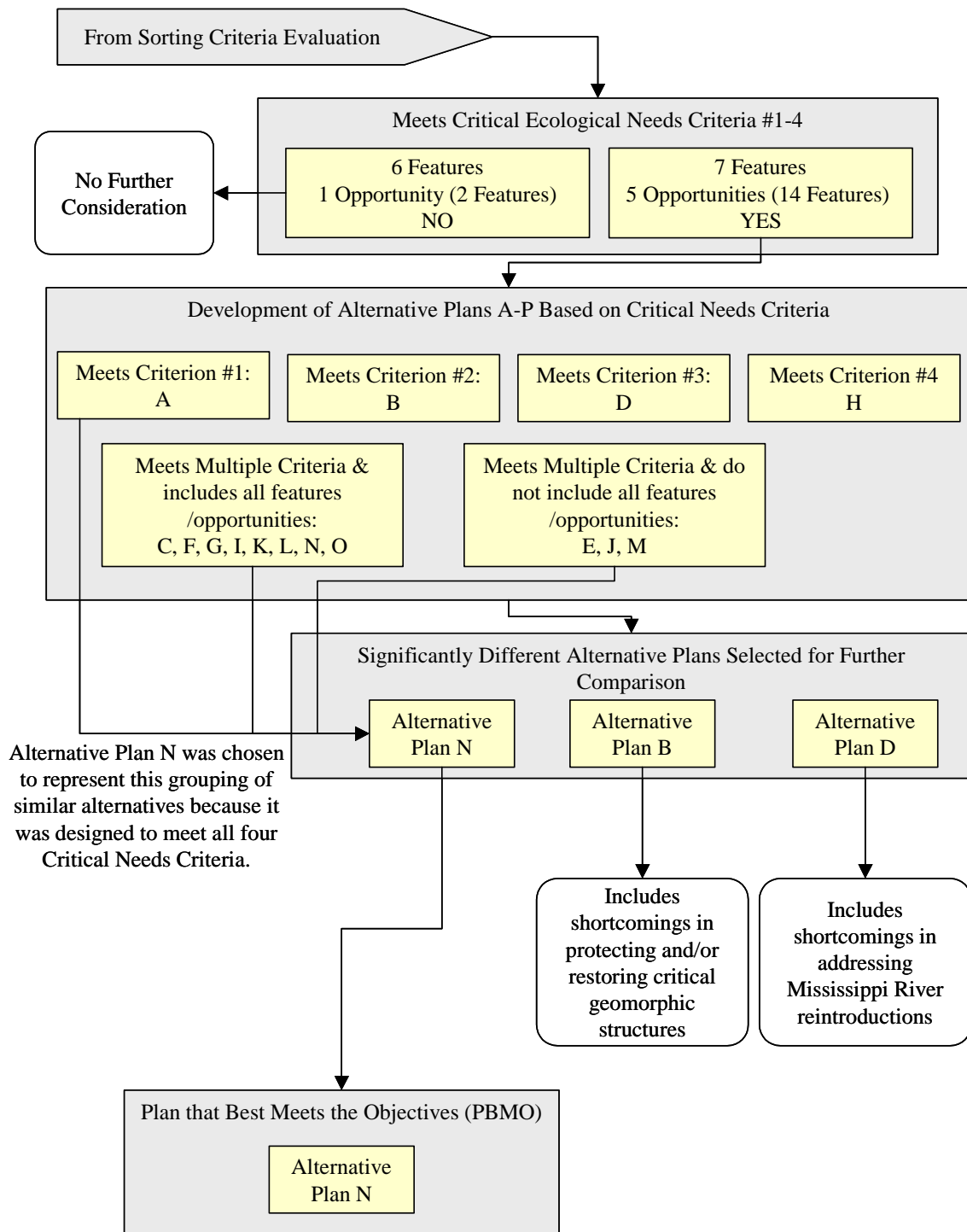


Figure E-52: Alternative Plan Development and Selection Based on Critical Needs Criteria.

7.6 Plan Formulation Results

7.6.1 Description of the Plan that Best Meets the Objectives

As discussed in section 3.2 PLAN FORMULATION RATIONALE and section 3.3 PLAN FORMULATION of the main report, the purpose of the LCA Study was to meet study objectives and thus identify a plan that is effective in addressing the most critical needs within the LCA. The most critical needs are located in those areas of the coast that, without attention, would experience a permanent or severely impaired loss of system stability and function. As such, the development and evaluation of alternative plans focused on identifying combinations of restoration features that best addressed these critical need areas.

The alternative plan that best meets the planning objectives (PBMO) is Alternative Plan N. Of the three alternative plans selected for further comparison, Alternative Plan N best meets the planning objectives and the Critical Needs Criteria.

In addressing the most critical ecologic needs of the Louisiana coast, this plan is also effective in meeting the defined study objectives. As presented previously in this report, the study objectives are as follows:

Hydrogeomorphic Objectives

1. Establish dynamic salinity gradients that reflect natural cycles of freshwater availability and marine forcing (tidal action or exchange).
2. Increase sediment input from sources outside estuarine basins, and manage existing sediment resources within estuarine basins, to sustain and rejuvenate existing wetlands and rebuild marsh substrate.
3. Maintain or establish natural landscape features and hydrologic processes that are critical to sustainable ecosystem structure and function.

Ecosystem Objectives

1. Sustain productive and diverse fish and wildlife habitats.
2. Reduce nutrient delivery to the Continental shelf by routing Mississippi River waters through estuarine basins while minimizing potential adverse effects.

7.6.2 Effectiveness of the Plan in Meeting the Study Objectives

The PBMO addresses the most immediate and critical needs of the ecosystem in attaining the study objectives. The rehabilitation of the coastal ecosystem by promoting the distribution of riverine freshwater, nutrients, and sediments using natural processes and ensuring the structural integrity of the estuarine basins is key to this sustainable solution. A sustainable ecosystem would support Nationally significant living resources, provide a sustainable and diverse array of fish and wildlife habitats, reduce nitrogen delivery to offshore gulf waters, and provide infrastructure protection and a sustainable resource base necessary to support NER goals.

The PBMO accomplishes the stated Hydrogeomorphic Objective 1. In the Deltaic Plain, the PBMO identifies reintroductions of freshwater from the Mississippi River in multiple locations from small to moderate scales.

The PBMO also addresses Hydrogeomorphic Objective 2 as the recommended actions for the Deltaic Plain are founded primarily on the introduction of Mississippi River water and sediments. The PBMO identifies one restoration feature and three restoration opportunities (composed of seven features) for the introduction of Mississippi River water and recommendations for the investigation of rehabilitation or modification of two existing diversion structures in the Deltaic Plain. In addition, the PBMO identifies two restoration features capitalizing on the direct introduction of Mississippi River sediments. The PBMO directs attention to many areas where the prevention of wetland loss is critical to maintaining the ability to provide sustainable coastal restoration in the future. In the Chenier Plain, the PBMO focuses on providing continued stability to preserve the viability of future restoration actions.

Major components of the PBMO in the Deltaic Plain are directed at meeting Hydrogeomorphic Objective 3. The conservation and restoration of barrier islands and shorelines are large components of protecting the coastline from storm damage. Restoration features of the PBMO include a critical headland area and a critical land bridge in the deltaic plain. Proposed features and opportunities, located across the entire coast, assure that landscape features are restored and maintained to provide additional potential protection from storm damage.

Ecosystem Objective 1 is addressed by the PBMO, which contributes to the increased introduction of Mississippi River water and sediment, the improved management of Atchafalaya River water in the Deltaic Plain, and the expansion of beneficial use of dredged material in the Chenier Plain. The features recommended in the Deltaic Plain provide significant improvements in connectivity and material exchange.

While the overall quantity of wetland area is projected to increase with the execution of the proposed restoration effort, the cumulative quantities of suitable habitat are projected to decline for some species in localized areas of the coast. However, it was estimated that the overall useable amounts of the various habitat types would remain relatively plentiful throughout the 50-year period analyzed. Based on earlier ecological model analysis, certain saline species are anticipated to experience the most significant change in habitat levels. For most species across the coast, suitable habitat levels are expected to remain at or slightly below current levels. It is expected that many freshwater-associated species should see increases in levels of suitable habitat. These trade-offs are consistent with the reintroduction of deltaic land building processes. Even with the anticipated changes in cumulative habitat suitability, overall diversity is expected to remain relatively high and close to current conditions in keeping with the ecosystem objective.

The effectiveness of the PBMO in achieving Ecosystem Objective 2 has also been taken into account. An Action Plan goal was developed by the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force and presented to Congress in January 2001. This goal calls for a 30 percent reduction in the mean annual load of total nitrogen delivered from the Mississippi

River basin to the Gulf of Mexico. Based on an average annual loading of 1.6 million metric tons (CENR, 2000), a 30 percent reduction would be 480,000 metric tons annually. In addressing the critical near-term needs of the coastal ecosystem, the PBMO would have a limited effect in achieving this goal. Since diversion of river flows on a large-scale, as a means of meeting the most critical needs of the system, is not achievable in the near-term there is future opportunity to expand on achieving this particular objective.

7.6.2.1 Environmental operating principles/achieving sustainability

Striving to achieve environmental sustainability is a core objective both for the development and for the implementation of an NER plan. Although the result of the LCA Study effort does not identify the final NER plan, the PBMO is focused on producing economic and environmental outcomes that will support and reinforce one another over both the near and long-term. The recognition of the interdependence of biological resources and the physical and human environment has driven the development of many of the guiding principals and tools applied in this study. As a result, the restoration features and opportunities that make up the PBMO produce balance and synergy between human development activities and natural systems.

The restoration features and opportunities in the PBMO that point toward additional investigations are intended to continue to shape activities and decisions currently under the authority of the USACE in order to increase the continued viability of the natural systems within which they occur. The PBMO is also intended to provide a mechanism to continue to assess and address cumulative impacts to the environment, and to achieve consistency by applying a systems approach to the full life cycle of all related water resources activities in the Louisiana coastal area.

7.6.2.2 Components of the Plan that Best Meets the Objectives (PBMO)

The PBMO consists of the components addressed below. These combined components represent the best near-term approach for addressing coastal wetlands loss in Louisiana. Although the features and opportunities addressed below do not necessarily represent those features and opportunities included in final implementation, the identified restoration features and opportunities represent optimal starting points for the detailed investigations that will lead to project justification and implementation. The projects that are ultimately authorized for construction would be optimized for location, scale, and beneficial output.

7.6.2.2.1 Near-term critical restoration features and opportunities

The first principal component of the PBMO is the group of features and opportunities identified to meet the critical near-term ecosystem needs of the Louisiana coastal wetlands. The restoration features and opportunities representing solutions to the Critical Needs included in the PBMO are:

- MRGO environmental restoration features
- Maurepas Swamp Reintroductions:
 - Small diversion at Hope Canal

- Small diversion at Convent/Blind River
- Increase Amite River Diversion Canal influence by gapping banks
- Barataria Basin barrier shoreline restoration-Caminada Headland, Shell Island
- Small Bayou Lafourche reintroduction
- Medium diversion at Myrtle Grove with dedicated dredging
- Calcasieu River Beneficial Use of Dredge Material
- Modification of Caernarvon Diversion for marsh creation
- Modification of Davis Pond Diversion for marsh creation
- Terrebonne marsh restoration opportunities:
 - Optimize flows and Atchafalaya River influence in Penchant Basin
 - Multi-purpose operation of Houma Navigation Canal (HNC) Lock
 - Convey Atchafalaya River water to Terrebonne marshes via a small diversion in the Avoca Island levee, repairing eroding banks of the GIWW, enlarging constrictions in the GIWW below Gibson and in Houma and Grand Bayou conveyance channel construction/enlargement
- Terrebonne Basin barrier shoreline restoration-Isles Dernieres, E. Timbalier Island
- Maintain land bridge between Caillou Lake and Gulf of Mexico
- Medium diversion at White's Ditch
- Gulf shoreline stabilization at Pt. Au Fer Island
- Lac Des Allemands area Reintroductions:
 - Small diversion at Lac Des Allemands
 - Small diversion at Donaldsonville
 - Small diversion at Pikes Peak
 - Small diversion at Edgard

7.6.2.2.2 Large-scale and long-term concepts requiring detailed study

The second principal component of the PBMO is the identification of large-scale, long-range studies of long-term restoration concepts. These long-range initiatives typically define fundamental changes to the hydrogeomorphic or ecologic structure, function, or management of the Louisiana coast. These concepts, which represent significant opportunities for coastal restoration, require detailed study and development to determine the probable impacts (beneficial and adverse) of such features in order to determine if these projects are desirable and can be integrated into the plan for coastal restoration. These concepts also include some levels of uncertainty, which are typically so extensive in scale that resolution through a demonstration project is impractical. As a general rule, large-scale diversions (flow greater than 15,001 cfs) were deemed impractical in the near-term because of their being mutually exclusive with significant concepts such as Third Delta. River resource hydrodynamic studies would necessarily evaluate these larger scale diversions in concert. The large-scale and long-term concepts identified in the PBMO include:

- Mississippi River Hydrodynamic Study
 - Mississippi River Delta Management Study
 - Third Delta Study

- Will incorporate relevant portions of Upper Atchafalaya Basin Study including evaluation of modified operational scheme of Old River Control Structure *funded under MR&T*
- Acadiana Bay Estuarine Restoration (includes Rebuilding Point Chevreuil Reef)
- Chenier Plain freshwater management and allocation reassessment

7.6.2.2.3 Science and Technology (S&T) Program and potential demonstration projects

The third principal component of the PBMO is the establishment of a S&T Program to address both near and long-term uncertainties in the implementation and execution of the plan. A portion of this component would include the execution of focused demonstration projects to resolve specific uncertainties and provide insight to the programmatic short and long-range implementation of the PBMO.